

**CONCEPTUALISING AND MEASURING SOCIAL  
CAMOUFLAGING IN AUTISM**

Laura Hull

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University College London (UCL)

Department of Clinical, Educational and Health Psychology

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## **DECLARATION**

I, Laura Hull, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

The following work was carried out at the Department of Clinical, Educational and Health Psychology, University College London, under the supervision of Doctor William Mandy and Professor KV Petrides. This thesis has not been submitted, in whole or in part, for any other degree, diploma, or qualification at any other university.

This thesis does not exceed the limit of 100,000 words specified by the Degree Committee.

Correspondence concerning this thesis should be addressed to Laura Hull, laurahull@btinternet.com.

Signed, 15<sup>th</sup> July 2019

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## **ABSTRACT**

Camouflaging has been proposed as a behaviour used by autistic individuals, particularly females, to minimise the appearance of autistic characteristics during social interactions. However, little is known about how autistic individuals camouflage and there are few validated measures of camouflaging. There is inconsistent evidence as to whether females camouflage more than males. This thesis addressed these issues by developing a conceptual model of camouflaging, developing and validating a self-report measure of camouflaging, and examining preliminary gender differences in camouflaging.

Six studies using qualitative and quantitative methods were undertaken. Study 1 used meta-analysis and systematic review to conclude that associated characteristics of autism may be expressed in unique ways in autistic females, forming a female autism phenotype.

Autistic adults' reported experiences of camouflaging were used to develop a conceptual model of camouflaging, from which future hypotheses can be derived (Study 2). In Study 3, a self-report measure of camouflaging behaviours (the Camouflaging Autistic Traits Questionnaire; CAT-Q) was developed from autistic adults' reported camouflaging strategies, and was validated in a large online sample of autistic and non-autistic males and females. Gender differences in adults' camouflaging were examined in Study 4.

Studies 5 and 6 further investigated the validity of the CAT-Q, in an adolescent sample. The CAT-Q was found to predict camouflaging success (Study 5), and some potential cognitive mechanisms underlying camouflaging were identified (Study 6). These studies also included preliminary investigations of gender differences in camouflaging success and its underlying mechanisms.

In summary, camouflaging involves compensation for and masking of autistic behaviours, and fitting in with others. A valid self-report measure of camouflaging has been developed, and has demonstrated greater camouflaging in autistic females than

males. This suggests camouflaging may form part of the female autism phenotype, with differential impacts for diagnosis and outcomes for males and females.

## **IMPACT STATEMENT**

The key contribution to methodology of this thesis is the development of the Camouflaging Autistic Traits Questionnaire (CAT-Q). The CAT-Q can be used academically, as a psychometrically valid self-report measure of camouflaging, and clinically, to complement current assessment tools. It is currently undergoing translation into seven additional languages.

The work presented in this thesis has gained attention from autistic groups, researchers, clinicians, and popular press internationally, and has generated requests for talks including at: Autism Hounslow; Great Ormond Street Hospital; Sheffield Autism Research Lab; Autism Today; and Public Health Wales. The work has also led to collaborations at the Universities of Amsterdam, Bristol, Cambridge, Leiden, Singapore, and Toronto.

The work in this thesis has already been widely disseminated in academic circles, including through academic publication and presentation:

A version of Chapter 1 is under review for publication at the *Review Journal of Autism & Developmental Disorders*.

A version of Chapter 2 has been published in *Autism*, downloaded over 3,000 times, and cited 27 times between December 2016 and July 2019. Details of the peer-reviewed article are below:

Hull, L., Mandy, W., & Petrides, K. V. (2017). Behavioural and cognitive sex/gender differences in autism spectrum condition and typically developing males and females. *Autism*, 21(6), 706–727. <https://doi.org/10.1177/1362361316669087>

A version of Chapter 3 has been published in the *Journal of Autism and Developmental Disorders (JADD)*, downloaded over 30,000 times, and cited 55 times between May 2017 and July 2019. Details of the peer-reviewed article are below:

Hull, L., Petrides, K. V., Allison, C., Smith, P., Baron-Cohen, S., Lai, M.-C., & Mandy, W. (2017). "Putting on My Best Normal": Social Camouflaging in Adults with Autism Spectrum Conditions. *Journal of Autism and Developmental Disorders*, 47(8). <https://doi.org/10.1007/s10803-017-3166-5>

A version of Chapter 4 has been published in *JADD*, downloaded over 11,000 times and cited once between October 2018 and July 2019. Details of the peer-reviewed article are below:

Hull, L., Mandy, W., Lai, M. C., Baron-Cohen, S., Allison, C., Smith, P., & Petrides, K. V. (2018). Development and Validation of the Camouflaging Autistic Traits Questionnaire (CAT-Q). *Journal of Autism and Developmental Disorders*, 49(3), 819–833. <https://doi.org/10.1007/s10803-018-3792-6>

A version of Chapter 5 has been accepted for publication in *Autism*. Details of the peer-reviewed article are below:

Hull, L., Lai, M.-C., Baron-Cohen, S., Allison, C., Smith, P., Petrides, K. V., & Mandy, W. (in press). Gender differences in self-reported camouflaging in autistic and non-autistic adults. *Autism*.

A version of Chapter 6 has been presented at the Autistica Discover Annual Conference (2019). Details are as follows:

Hull, L., Petrides, K.V. & Mandy, W. (2019). *Does camouflaging affect how an autistic teenager is perceived by non-autistic people?* Oral presentation. Autistica Discover Annual Conference, Reading, UK, June 27.

A version of Chapter 7 has been presented at the International Society for Autism Research (INSAR) Annual Meeting (2019). Details are as follows:

Hull, L., Petrides, K.V. & Mandy, W. (2019). *Cognitive predictors of autistic adolescents' camouflaging*. Poster presentation. INSAR annual meeting, Montreal, Canada, May 1-4.

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## **LIST OF ABBREVIATIONS**

ADI-R – Autism Diagnostic Interview – Revised

ADOS-2 – Autism Diagnostic Observation Schedule – Version 2

ANCOVA – Analysis of Covariance

ANOVA – Analysis of Variance

AQ – Autism Spectrum Quotient

ASC – Autism Spectrum Condition

ASD – Autism Spectrum Disorder

BAP – Broader Autism Phenotype

BAPQ – Broad Autism Phenotype Questionnaire

BRIEF-2 – Behaviour Rating Inventory of Executive Function, 2<sup>nd</sup> Edition

CARD – Cambridge Autism Research Database

CAT-Q – Camouflaging Autistic Traits Questionnaire

CD – Camouflaging Discrepancy

CSS – Calibrated Severity Score

DSM-5 – Diagnostic and Statistical Manuals, 5<sup>th</sup> Edition

EMB – Extreme Male Brain

EQ – Empathising Quotient

FAP – Female Autism Phenotype

FPE – Female Protective Effect

FQ – Friendship Questionnaire

ICD-10 – International Classification of Diseases for Mortality and Morbidity Statistics – Tenth Revision

ICD-11 – International Classification of Diseases for Mortality and Morbidity Statistics – Eleventh Revision

IQ – Intelligence Quotient

MANCOVA – Multivariate Analysis of Covariance

NICE – National Institute for Health and Care Excellence

PDD – Pervasive Developmental Disorder

PDD-NOS – Pervasive Developmental Disorder, Not Otherwise Specified

RRBIs – Restricted and Repetitive Behaviours and Interests

SMD – Standardised Mean Difference

SQ – Systemising Quotient

TD – Typically Developing

UCL – University College London

WASI – Wechsler Abbreviated Scale of Intelligence

## **CONTRIBUTIONS**

Study 1 (reported in Chapter 2): I conceived of the study with KV Petrides and Will Mandy. I screened and identified studies and conducted the systematic review and meta-analyses. I wrote the chapter. All co-authors contributed to and approved the final version of the chapter.

Study 2 (reported in Chapter 3): I conceived of the study with Will Mandy, Meng-Chuan Lai, Simon Baron-Cohen, Carrie Allison, Paula Smith, and KV Petrides. I collected data, conducted qualitative analyses, and wrote the chapter. All co-authors contributed to and approved the final version of the chapter.

Study 3 (reported in Chapter 4): I conceived of the study with Will Mandy, Meng-Chuan Lai, Simon Baron-Cohen, Carrie Allison, Paula Smith, and KV Petrides. I collected data, conducted the statistical analyses, and wrote the chapter. All co-authors contributed to and approved the final version of the chapter.

Study 4 (reported in Chapter 5): I conceived of the study with Will Mandy, Meng-Chuan Lai, Simon Baron-Cohen, Carrie Allison, Paula Smith, and KV Petrides. I collected data, conducted the statistical analyses, and wrote the chapter. All co-authors contributed to and approved the final version of the chapter.

Study 5 (reported in Chapter 6): I conceived of the study with Will Mandy and KV Petrides. I collected data with support from Louise Chapman, Ben Hannon, and Aaron Wiener-Blotner. I conducted the statistical analyses and wrote the chapter.

Study 6 (reported in Chapter 7): I conceived of the study with Will Mandy and KV Petrides. I collected data with support from Louise Chapman, Ben Hannon, and Aaron Wiener-Blotner. I conducted the statistical analyses and wrote the chapter.

## **SUMMARY OF THESIS**

Camouflaging of autistic characteristics has been reported anecdotally by autistic people, families, and clinicians but had received limited academic attention prior to this thesis. Most academic focus had considered camouflaging as one potential explanation for the underdiagnosis of autism in females. In particular, little was known about how autistic people camouflage or the potential implications for long-term wellbeing. There were also few reliable or validated measures of camouflaging. This thesis used a combination of qualitative and quantitative methods to conceptualise camouflaging in autism, develop and validate a measure of camouflaging in autism, and explore the role of camouflaging in the female autism phenotype.

The first chapter offers a general introduction to questions of gender in autism, with a focus on better understanding gender disparities in diagnosis. Two complementary explanations for these diagnostic disparities are discussed, the female protective effect and female autism phenotype (FAP) hypotheses. The chapter then focuses on one particular aspect of the FAP, namely camouflaging of autistic characteristics, arguing that this is an important topic which, prior to this thesis, was under-researched. Previous and contemporary research into camouflaging is summarised, and conceptual and measurement issues are discussed which will be addressed in the remainder of the thesis.

Chapter 2 (Study 1) is a meta-analysis and systematic review of all research into gender differences in autistic and non-autistic cognitive and behavioural characteristics as of September 2015. The gender differences unique to autism described here provide evidence for the broader existence of the FAP, beyond the gender differences found in the general population. This provides justification for the continued examination of one proposed component of the FAP; camouflaging of autistic characteristics.

Chapter 3 (Study 2) describes an exploratory study seeking to conceptualise camouflaging through qualitative assessment of autistic adults' experiences of

camouflaging. A conceptual model is developed, which is used in the remainder of the thesis as a theoretical framework for measure development and generation of hypotheses.

Chapter 4 (Study 3) details the development and validation of a self-report measure of camouflaging (the Camouflaging Autistic Traits Questionnaire; CAT-Q) in a large sample of autistic and non-autistic adults. Construct validity is demonstrated through internal consistency, test-retest reliability, and comparison with theoretically related constructs, and measurement invariance is demonstrated in autistic and non-autistic males and females, allowing for mean score comparison across these groups.

Gender differences in autistic and non-autistic adults are examined in Chapter 5 (Study 4) using the CAT-Q. Greater camouflaging is reported by autistic females than males, when controlling for autistic traits. No gender difference is found between non-autistic females and males, suggesting that camouflaging forms part of the female autism phenotype.

Chapter 6 (Study 5) further validates the CAT-Q through comparison with another measure of camouflaging and with a proxy for camouflaging success, in a sample of autistic adolescents. The use of self-report and parent-report methods for measuring camouflaging in this population is discussed. CAT-Q score is associated with more positive social impression when camouflaging, suggesting that camouflaging intention and success are related, and in preliminary analyses this relationship is stronger for females than for males.

Chapter 7 (Study 6) examines some proposed cognitive predictors of camouflaging in an effort to understand the mechanisms involved in successful camouflaging. Predictors of camouflaging are examined for total camouflaging and subscale scores, and for both self- and parent-reported CATQ. Fewer executive function difficulties and lower social motivation predicted greater self-reported camouflaging in autistic adolescents. Exploratory analyses in each gender suggest that executive function plays a specific role



for males' camouflaging in particular. There were no significant predictors of parent-reported camouflaging.

Finally, Chapter 8 considers the findings of this thesis in relation to the aims of conceptualisation and measurement of camouflaging, and offers suggestions for future research, as well as implications for policy and practice. In particular, the impact of camouflaging in the context of autism diagnostic assessment and the female autism phenotype are discussed, and practical adaptations to improve the accuracy of diagnosis and research are considered.

## **CHAPTER 1. GENERAL INTRODUCTION**

### **1.1 Autism Spectrum Disorder**

Autism spectrum disorder (hereafter ‘autism’) is a lifelong neurodevelopmental condition characterised by differences in social communication and interaction, and by restricted and repetitive patterns of behaviour and interests (American Psychiatric Association, 2013; World Health Organization, 2018). This latter characteristic includes difficulty adapting to change or uncertainty, focused interests which are of much greater intensity than those found in typically developing peers, and over-or under-sensitivity to sensory stimulation. To obtain a clinical diagnosis of autism, characteristics must have been present since infancy and cause significant impairment to everyday functioning. In this thesis, I refer to autism spectrum disorder as ‘autism’ because some members of the autism community feel the label ‘disorder’ produces stigma and emphasises the difficulties associated with autism while minimising the strengths. For similar reasons, I use identity-first language (‘autistic person’) throughout to respect the preferences of a majority of autistic people (Kenny et al., 2015).

Outcomes and abilities for autistic individuals range from living fully independent lives to requiring full-time residential care, and both abilities and outcomes can change over the course of an individual’s development, depending on many different factors. Approximately 30%-50% of autistic children and adults have a co-occurring intellectual disability (Christensen et al., 2018; Matson & Shoemaker, 2009). Intellectual ability is one of the strongest predictors of long-term outcomes of autism, with IQ in the typical range associated with greater independence and more positive outcomes across the lifespan (Ben-Itzhak & Zachor, 2019; Poon & Sidhu, 2016). Co-occurring physical and mental health conditions are more likely amongst autistic individuals than in the general population (Buck et al., 2014; Kohane et al., 2012). Autistic individuals are at greater risk of death from these co-occurring conditions than the general population (Schendel et al., 2016).

However, autistic people can also have unique strengths and differences in ability which contribute to a neurodiverse community. Some autistic people have strong pattern-recognition and discrimination abilities (Charman et al., 2011; Noterdaeme, Wriedt, & Höhne, 2010), and many are especially good at understanding the mechanisms or systems of complex models (Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003). For many people, their special interests can be a source of wellbeing and may be used as the basis for work or other activities (Grove, Hoekstra, Wierda, & Begeer, 2018). Approximately 60% of autistic people in the US who completed school education are employed or complete further education (Lounds Taylor, Henninger, & Mailick, 2015; Shattuck et al., 2012).

There is limited research on education and employment outcomes in the UK, but smaller studies suggest that around 30% of autistic adults without intellectual disability are employed (Moss, Howlin, Savage, Bolton, & Rutter, 2015), while between 20-50% of adults have completed secondary education (Howlin, 2003). While ideal outcomes vary for individuals, and may also vary across the lifespan, it is regularly concluded that autistic people are undereducated, underemployed, and that their abilities, talents, and personal interests are underutilised (Frank et al., 2018; Meyer, Powell, Butera, Klinger, & Klinger, 2018). However, it is also important to measure outcomes and quality of life based on what the individual and/or their family perceive as good or meaningful, as some neurotypical (i.e. non-autistic) 'successful' outcomes such as employment or close relationships may not be considered necessary or desirable by some autistic people (McChesney & Toseeb, 2018; McConachie et al., 2017; Sosnowy, Silverman, & Shattuck, 2018).

## **1.2 Causes**

Autism has been well established as a highly heritable condition; there is higher concordance between monozygotic than dizygotic twins (Ronald & Hoekstra, 2011), and heritability is estimated between 64 – 94% (Tick, Bolton, Happé, Rutter, & Rijdsdijk, 2016).

The vast majority of this genetic contribution is proposed to be the result of additive effects of multiple inherited mutations found in the general population (Gaugler et al., 2014), which contributes to around 50% of genetic variance. This additive effect is especially likely in families with multiple autistic people (Sasson, Lam, Parlier, Daniels, & Piven, 2013). In contrast, spontaneous genetic mutations may more commonly underlie cases in which there is only one person with autism in a family (Chaste & Leboyer, 2012). These de novo mutations account for a very small amount of overall genetic variance, but may contribute substantially to individual likelihood of developing autism, especially when multiple de novo mutations interact (Gaugler et al., 2014; Sandin, Lichtenstein, Larsson, Hultman, & Reichenberg, 2014; Sato et al., 2012; Vaags et al., 2012). There have also been suggestions that autism represents a collection of similarities in the behavioural expression of multiple different genetic conditions (Betancur, 2011; Happé, Ronald, & Plomin, 2006).

Proposed environmental causes of autism, including the false suggestions of parenting style (Wolff, 2004) and vaccines (DeStefano & Thompson, 2004), have had significant impact on public (mis)beliefs and health behaviours. However, demonstrable factors for autism include in-vitro exposure to toxins and certain medications (Bjørklund et al., 2018; Gardener, Buka, & Spiegelman, 2013), and prenatal maternal infections (Chaste & Leboyer, 2012). More general environmental factors including parental and family migration (Magnusson et al., 2012) and greater parental age (maternal and paternal; Sandin et al., 2016), have also been identified as significantly contributing to likelihood of developing autism. These factors are likely to interact with genetic dispositions, with the interactive effects of environment and genes varying across the course of an individual's development (Lichtenstein, Carlström, Råstam, Gillberg, & Anckarsäter, 2010; Mandy & Lai, 2016).

### **1.3 Prevalence and diagnosis**

Estimates of autism prevalence are continually updated. The most recent estimates suggest a prevalence of 1 in 69 children in America (Christensen et al., 2018), with similar estimates in the UK of 1 in 59 (Russell, Rodgers, Ukoumunne, & Ford, 2014). Prevalence estimates are most often determined in western, higher-developed nations, and these tend to be higher than those estimated in low-income countries (Elsabbagh et al., 2012). This could suggest that there are significant numbers of autistic people in other nations who are not recognised, and who are not receiving support from medical or educational systems. Alternatively, there may be lifestyle factors in more developed nations which lead to greater incidence of autism. Autism diagnosis has traditionally been most common in childhood, when differences from neurotypical peers may first become obvious. However, in recent years there has been a significant increase in the rate of adult diagnosis, particularly as diagnostic criteria have been broadened such that individuals who would not have received an autism diagnosis in childhood may now meet current diagnostic criteria (Happé et al., 2016). Access to adult diagnosis is limited in many parts of the UK, however, and there is limited post-diagnostic support available at present (Crane et al., 2018).

As there are no reliable diagnostic biomarkers of autism, the condition is diagnosed behaviourally, based on observation and description of the core characteristics impacting everyday functioning to a 'clinically significant' degree (American Psychiatric Association, 2013; World Health Organization, 2018). In the UK, National Institute for Health and Care Excellence (NICE) guidelines specify that autism in under 19s must be diagnosed following, amongst other assessments, a developmental history and assessment of the child's social and communication abilities using observation and interaction (NICE, 2017). It is also recommended that autism-specific tools are used. Some of the most common assessment tools include parental and/or adult interviews, such as the Autism Diagnostic Interview – Revised (ADI-R; Le Couteur, Lord, & Rutter,

2003), Diagnostic Interview for Social and Communication Disorders (DISCO; Wing, Leekam, Libby, Gould, & Locombe, 2002), Developmental, Dimensional and Diagnostic Interview (3Di; Skuse et al., 2004), 3Di Adult Version (Mandy et al., 2017); and behavioural observation tools, such as the Autism Diagnostic Observation Schedule – Version 2 (ADOS-2; Lord et al., 2012). Screening questionnaires such as the Childhood Autism Spectrum Test (CAST; Scott, Baron-Cohen, Bolton, & Brayne, 2002) or Autism Quotient (AQ; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) may also be used to flag those with higher levels of autistic characteristics for further in-depth assessment. However, an autism diagnosis is ultimately the result of discussion and consensus by the expert or team assessing the individual in relation to DSM-5/ ICD-11 criteria (NICE, 2017), and therefore individuals do not necessarily need to meet all thresholds on the tools described above to receive a diagnosis.

#### **1.4 Gender differences in diagnosis<sup>1</sup>**

Autism is more commonly diagnosed in males than in females across age groups (Fombonne, 2009; Russell, Steer, & Golding, 2011). When screening the entire population using gold standard assessments, current estimates suggest around three males receive an autism diagnosis for every female; however in clinical samples who have already received an autism diagnosis, that ratio is higher at over four males to each female (Loomes, Hull, & Mandy, 2017). In individuals with intellectual disability the ratio is closer to 2:1 (Yeargin-Allsopp & Rice, 2003).

When attempting to account for the discrepancies in diagnosis, researchers have drawn upon two distinct ideas, which are contrasting but not mutually exclusive. One argues that there is something inherent in being female that ‘protects’ females from the likelihood

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<sup>1</sup> In this thesis I refer to ‘gender’ as the socially constructed identities individuals form for themselves, informed by the interaction between physiological characteristics, social norms, and roles within a specific society (World Health Organization, 2011). In many, but not all, of the studies described in this thesis, ‘gender’ is used as equivalent to ‘sex’ (identities assigned at birth, usually based on physiological characteristics). However, where studies report both sex and gender identities of groups or individuals, explicit reference is made to both these terms.

of developing autism. The other proposes that females may be more likely to develop autism than we currently estimate, but that diagnostic biases and variation in the ways autism is expressed in females mean we do not pick up autism in females to the same degree as males.

#### 1.4.1 Female Protective Effect

The Female Protective Effect Theory (FPE theory) comes from research into potential genetic and environmental factors affecting autism development. It proposes that females require greater environmental and/or genetic risk than males to express the same degree of autistic characteristics, and, hence, that females are 'protected' from autistic characteristics relative to males with a comparable level of risk factors (Robinson, Lichtenstein, Anckarsäter, Happé, & Ronald, 2013). In support of FPE, autistic females possess more spontaneous, non-inherited mutations associated with autism than males (Gilman et al., 2011; Levy et al., 2011). Males and females in these studies had comparable levels of autistic characteristics, suggesting that a greater genetic hit is required for females to express a phenotype that meets the diagnostic threshold. This implies an innate protective factor in females, which results in reduced behavioural expression of autistic characteristics when the genetic risk of autism is equivalent to that of males.

If, as FPE suggests, females are, on average, protected against autism compared to males, then autistic females should have greater genetic load than males in order to express the same level of characteristics. As the majority of variance in autism is inherited (Tick et al., 2016), their close genetic relatives should also carry more genetic load for autism than the close relatives of autistic males; in other words, relatives of autistic females should be more likely to have autism, or autistic characteristics, than relatives of autistic males. Evidence for this hypothesis is mixed. While some studies suggest autistic females' first degree relatives have more autistic characteristics than

first-degree relatives of autistic males (Desachy et al., 2015; Frazier et al., 2015), others have found the opposite distribution of autistic characteristics (Ozonoff et al., 2011).

A further limitation to FPE is that no specific protective factor has been conclusively demonstrated as yet. Some proposed candidates will be discussed here. The Extreme Male Brain theory (EMB theory) proposes that androgens and related sex hormones more common in males may underlie many autistic characteristics (Baron-Cohen, 2002). Characteristics associated with autism, such as high levels of systemising abilities and difficulties with cognitive empathy and emotional expression tasks, are proposed to represent masculine characteristics, such that autistic individuals are presented as having 'extreme male' behavioural and psychological presentations (Baron-Cohen, 2002). The EMB theory suggests that individuals with lower levels of androgens (i.e., females) also demonstrate lower levels of these characteristics, and therefore that having low levels of androgens is protective against autistic characteristics (Baron-Cohen et al., 2015; Baron-Cohen et al., 2011). A relationship between autistic characteristics and high androgen levels in females has been found (Knickmeyer et al., 2006; Schwarz et al., 2011); however, other research suggests that foetal and early developmental androgen levels have a very limited relationship with autism diagnosis (Guyatt, Heron, Knight, Golding, & Rai, 2015).

Another proposed source of the protective factor is the X chromosome, with a protective gene expressed on the paternal X chromosome for females, which increases the threshold for autism expression relative to males (Skuse, 2000); however, no specific protective gene has been identified here. Environmental factors such as in-vitro exposure to medications seem to increase autism likelihood in males more than females (Harrington, Lee, Crum, Zimmerman, & Hertz-Picciotto, 2014). These factors may interact with genetic risks to further increase autism likelihood in males, and hence increase relative autism protection in females. Further research is undoubtedly needed



to identify the protective and risk factors involved in male and female autism development.

A key limitation of research into relative male and female risks of autism is that most studies assume current estimates of male and female diagnostic rates are accurate. As will be discussed in detail below, this may not necessarily be the case. If autistic females are in fact less likely to be diagnosed than are autistic males, despite demonstrating equivalent levels of autistic characteristics, there may be genetic or behavioural differences between those females who do receive an autism diagnosis and those who do not. Evidence for the FPE comes from studies of autistic females who meet current diagnostic criteria, using current diagnostic tools. Females who do not meet current criteria using these tools, for reasons that will be discussed below, may also have lower genetic risk, or display genetic variations that have not yet been associated with autism. Conclusions as to the generalisability of the FPE to all autistic females must, therefore, be limited until it can be demonstrated that all autistic females are included in these genetic analyses.

#### 1.4.2 Female Autism Phenotype

Even if biological factors exist to reduce the likelihood of autism in females, there is also evidence suggesting that diagnostic processes are biased against females, particularly those without intellectual disability (Russell et al., 2011). Females require substantially more additional difficulties than males to receive an autism diagnosis, despite having equivalent levels of autistic characteristics (Duvekot et al., 2016; Dworzynski, Ronald, Bolton, & Happé, 2012; Shattuck et al., 2009). Clinical samples appear to underestimate the number of females, as male:female ratios are significantly higher in these than in community-based samples in which all individuals are screened for autism (Loomes et al., 2017). In addition, females who do receive an autism diagnosis do so at a later age than males on average (Begeer et al., 2013; Kirkovski et al., 2013; Rutherford et al., 2016). A fundamental issue with the current diagnostic procedure is that behavioural

markers used as diagnostic criteria are established based on pre-existing conceptions of what autistic behaviours look like. These criteria have been developed based on the predominantly male populations previously identified as autistic (Kirkovski et al., 2013; Kopp & Gillberg, 2011; Mattila et al., 2011). Females may be less likely to meet these criteria even when clinically significant characteristics are identified, resulting in diagnoses of broader developmental disorders, rather than autism specifically (Langmann, Becker, Poustka, Becker, & Kamp-Becker, 2016; Wilson et al., 2016).

Individual characteristics may interact with gender to further reduce the likelihood of females receiving an autism diagnosis. Females with low IQ are more likely to receive a diagnosis than females with high IQ (Rivet & Matson, 2011; van Wijngaarden-Cremers et al., 2014). Total rates of autism diagnosis have increased over time, representing in part a broadening of diagnostic criteria to include individuals with greater variation in presentation (Brugha et al., 2011; Saemundsen, Magnússon, Georgsdóttir, Egilsson, & Rafnsson, 2013); although trends towards increased prevalence appear to be mostly driven by diagnoses of boys without intellectual disability (Blumberg et al., 2013). There is also some evidence to suggest that adult women are seeking and receiving autism diagnoses to a greater extent than men (Happé et al., 2016), supporting the argument that these women were even more likely to be missed at a younger age than their male peers.

One explanation for the underdiagnosis of females is that their presentation of autism is qualitatively different to the typical male presentation. This female phenotype, or female behavioural expression of autism, represents similar core autistic characteristics as those described in current diagnostic criteria (i.e. difficulties with social communication and interaction, restricted interests and repetitive behaviours, and unusual sensory responses). However, these characteristics may be expressed in ways that differ from traditional ideas of autism (Kirkovski et al., 2013; Lai et al., 2011). Females may also express other, additional behaviours or characteristics that are not currently included in

autism diagnostic criteria. Evidence for gender differences related to the Female Autism Phenotype (FAP) in cognitive and behavioural characteristics of autism are examined in the systematic review presented in Chapter 2. Behaviours which have been explicitly proposed as part of the FAP are briefly discussed here.

#### 1.4.2.1 Social Relationships

Difficulties with social relationships, particularly friendships, are a hallmark of autism (American Psychiatric Association, 2013). The FAP theory suggests that the nature of these difficulties may differ depending on an individual's gender. Some research has suggested autistic females may have fewer social impairments than males; autistic females tend to have higher levels of social motivation (the desire and intent to form friendships or relationships with others) than males on average (Head, McGillivray, & Stokes, 2014; Hiller, Young, & Weber, 2014). However, autistic females may find it harder to maintain long-term friendships or relationships than autistic males, despite having similar levels of motivation for social relationships as non-autistic females (Hiller et al., 2014). Conflict in social relationships may also be harder for autistic females to cope with than autistic males or non-autistic females (Sedgewick, Hill, & Pellicano, 2018). These findings suggest that in addition to assessing the maintenance of social relationships, research into the female autistic experience should also compare with non-autistic female characteristics to obtain an accurate evaluation of relative social abilities. When compared to autistic males, females may appear to have fewer social difficulties overall, but may struggle with other aspects of socialising, especially in comparison to non-autistic females.

#### 1.4.2.2 Relational Interests

In a similar vein, some research into gender differences in restricted and repetitive interests has suggested that autistic females have lower levels of these interests than males (Hattier, Matson, Tureck, & Horovitz, 2011; Lai, Lombardo, Auyeung, Chakrabarti, & Baron-Cohen, 2015). However, some have argued that autistic females' special

interests may be in different areas to males, and so may be underestimated if these areas are not probed during assessments or are not considered 'atypical' (Antezana et al., 2018; Mandy et al., 2012). Further research explicitly comparing the nature of males' and females' special interests in autism appears to support this. Autistic males' interests tend to be focused on more mechanical objects such as vehicles, computers or transport systems (Grove et al., 2018). On the other hand, autistic females' interests appear to focus more on objects with relational purposes, such as animals, celebrities, or fictional characters (Grove et al., 2018; Mandy et al., 2012; Mcfayden, Albright, Muskett, & Scarpa, 2018). However, studies in adults suggest this may not always be the case, and that more research is needed to examine the type of interests across all ages (Nowell, Jones, & Harrop, 2019).

While the intensity of the interest itself may be atypical for both genders, the type of interest may be considered more age and gender appropriate for females than males, and so may not be reported as unusual by parents, teachers, or clinicians (Lai et al., 2015; Sutherland, Hodge, Bruck, Costley, & Klieve, 2017). Alternatively, because the interest is seen as more appropriate it may create fewer difficulties for the autistic individual and their family, and not be considered clinically significant. Nevertheless, the differential nature of special interests may result in underestimation of autistic characteristics for autistic females, and so reduce the likelihood of a clinical diagnosis.

#### 1.4.2.3 Internalising Problems

The previous two characteristics of the female autism phenotype concern differential expression of the core underlying features of autism. The next characteristic, namely internalising problems, concerns features which may form part of the typical clinical presentation, but do not represent the core features of autism. In contrast to externalising problems (where difficulties are turned outwards, resulting in aggression and problems relating with others), internalising problems describe the inward expression of emotional difficulties, including anxiety, depression, self-harming, and eating disorders (Kovacs &

Devlin, 1998; Leadbeater, Kuperminc, Blatt, & Hertzog, 1999). Most research demonstrates that autistic females are significantly more likely to have co-occurring internalising disorders than males, and these increase in severity at a greater extent than for males, although some studies with younger children find no variation between genders (Chandler et al., 2016; Gotham, Brunwasser, & Lord, 2015; Mandy et al., 2012; Oswald et al., 2016). Autistic males are significantly more likely than females to have co-occurring externalising disorders such as behavioural problems and inattention (Hiller et al., 2014; May, Cornish, & Rinehart, 2012).

There are two ways in which this may impact the identification of female autism. Firstly, more severe expression of these co-occurring conditions may serve to mask underlying autistic characteristics, such that females receive a diagnosis of the co-occurring condition only, and their autism goes unrecognised. This has been reported anecdotally by many autistic women who received an autism diagnosis later in adulthood, after earlier diagnoses of internalising conditions (Bargiela, Steward, & Mandy, 2016). Secondly, if males tend to express their co-occurring conditions in more disruptive ways than females, this may perpetuate the gender bias in autism recognition and referral, particularly in school. The needs of autistic males may come to teachers' attention sooner and be seen as more intrusive than females, who may be seen as shy or simply anxious (Hiller et al., 2014). Females' internalising difficulties may, therefore, not only leave them more vulnerable to serious mental health conditions, but also reduce the likelihood of their autism being recognised.

### **1.5 Camouflaging**

One aspect of the female phenotype which has, until recently, received relatively limited attention, is the phenomenon of camouflaging. Camouflaging refers to the use of conscious or unconscious strategies, which may be explicitly learned or implicitly developed, to minimise the appearance of autistic characteristics during a social setting (Lai et al., 2011). Examples include mimicking facial expressions of the person you are

talking to (whether consciously or not) or forcing oneself to make eye contact and to stop talking about an interest. A similar concept which has been recently proposed is that of compensation (Livingston & Happé, 2017). Compensation describes the use of alternative cognitive strategies to overcome specific socio-cognitive or behavioural difficulties in autism. For instance, an autistic individual might compensate for theory of mind difficulties by using executive function strategies to learn to recognise different facial expressions. Compensation can be shallow (involving external changes without affecting the underlying cognitive processes) or deep (using alternative cognitive routes to achieve the desired outcome; Livingston & Happé, 2017), and evidence of varying levels of compensation has been presented in autistic individuals (Livingston, Colvert, Bolton, & Happé, 2018). As described in Chapter 3, 'compensation' is also used in this thesis to describe a sub-type of camouflaging behaviours used to compensate for autism-related difficulties, which may include compensatory strategies as described by Livingston and colleagues.

The concepts of compensation and camouflaging have evolved independently and concurrently, and therefore it is still unclear to what extent both concepts refer to the same underlying construct. However, camouflaging has been conceptualised at the behavioural level and so describes behavioural outcomes which may come about through either cognitive or behavioural strategies. In contrast, compensation developed through a cognitive focus and so describes cognitive processes which may also lead to behavioural change. As demonstrated in Figure 1.1, it is possible for compensation to occur with or without a behaviourally identifiable outcome (in this example, theory of mind ability could improve without impacting how an individual interacts with others in everyday life); similarly, camouflaging could occur with or without changes in cognitive patterns (for example, through unconscious, automatic mimicry of others during social interactions).

Additionally, compensation describes the processes used to compensate for difficulties associated with autism, whereas camouflaging describes the adaptation of behaviours whether or not they result in impairments for the individual (Livingston et al., 2018). As a result, camouflaging can impact one's entire autistic presentation, including areas not related to socio-cognitive difficulties, whereas compensation might only produce changes in the specific characteristic compensated for. More research is needed to identify how the concepts of camouflaging and compensation overlap and/or are separate, and in particular to develop ways of identifying the alternative cognitive routes thought to promote 'deep' compensation, potentially through brain imaging to identify alternative neural pathways (Livingston & Happé, 2017).

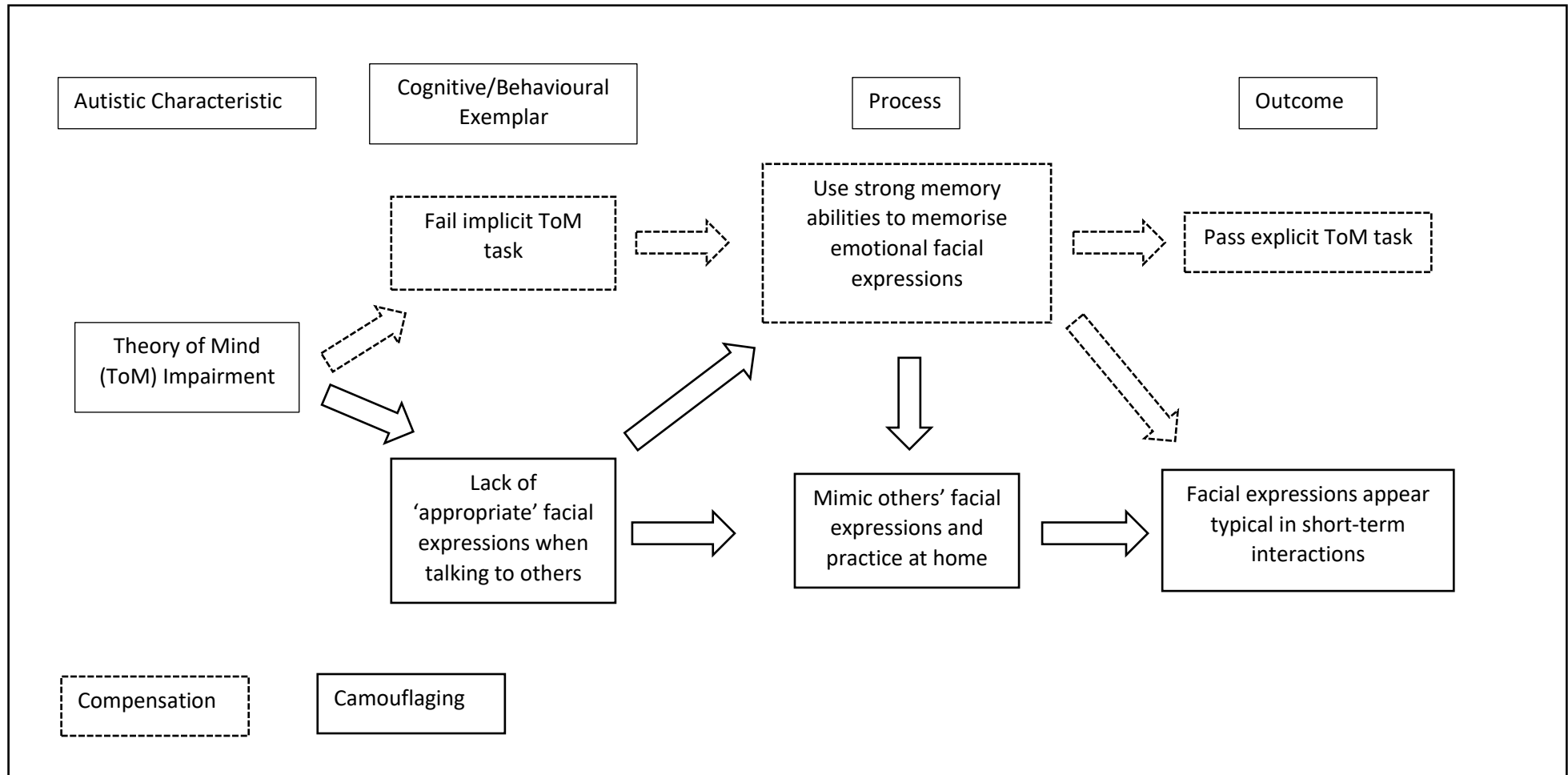


Figure 1.1. Comparison of Camouflaging (solid lines) and Compensation (dashed lines) through the example of Theory of Mind impairment



### 1.5.1 Camouflaging by autistic females

Some of the first references to autistic camouflaging and similar concepts appear in sources attempting to describe or explain the gender disparity in diagnosis, especially amongst individuals without intellectual impairment. As early as 1981, Lorna Wing hypothesised that some autistic girls with no intellectual disability may be missed in clinical assessments, and that this may be related to females appearing to have better social and communication abilities compared to males (Wing, 1981a). This has come to be known as the 'camouflaging hypothesis'. She also described case studies of male and female individuals using strategies to learn rules or social behaviours, for example from television shows or books, which may appear typical at first glance and may make diagnosis harder. Again, it was emphasised that this may have a greater effect in females than in males: "The girls tended to appear superficially more sociable than the boys, but closer observation showed that they had the same problems of two-way social interaction" (Wing, 1981b; p 120).

Historically, autistic women writing about their own experiences have described behaviours and outcomes conceptually related to camouflaging; Liane Holliday Wiley described "pretending to be normal" (Holliday Willey, 2015) for many years before receiving her diagnosis. However, these accounts were not always considered by clinicians or academics seeking to understand the female autistic experience. The hypothesis of specific strategies being used by girls to mask autistic social difficulties was also noted in case studies by Kopp and Gillberg (1992). Again, the emphasis was on superficially typical social behaviour, but identification of underlying difficulties upon further examination: "She is good at imitating superficial social skills and says all the right things on first meeting new people. However, shortly thereafter she completely ignores them" (p 95). The authors suggested that these behaviours represented part of a 'female phenotype' of Aspergers, which might require adapted assessment tools or thresholds. This concept has been extended in later work seeking to identify more subtle

presentations of social and communication difficulties in autistic girls (Kopp & Gillberg, 2011).

Descriptions of camouflaging at this stage of conceptualisation focused on personal and clinical anecdotes, or hypotheses produced in the discussion section of related studies. Some specific behaviours that may represent camouflaging were proposed, although up to this point these ideas had not been tested in large-scale, high-quality studies. Suppressing physical characteristics such as hand flapping, giving scripted responses to questions, and imitating others' facial expressions were all proposed as possible methods of camouflaging based on case studies and clinician or researcher experience (Kreiser & White, 2014; Lai & Baron-Cohen, 2015; Mandy & Tchanturia, 2015). Strategies such as staying close to other girls to avoid standing out (Gould & Ashton-Smith, 2011), or adapting to school environments so difficulties were not identified by teachers (Hiller et al., 2014; Mandy et al., 2012) have also been proposed.

Although camouflaging had not yet been directly measured at that time, some suggestions were formed as to the mechanisms involved. It was proposed that autistic girls and women might identify and learn appropriate behaviours from others, especially peers, and that social expectations and reinforcements might have a greater influence on females than males in many cultures, increasing the importance of displaying the 'right' behaviours (Kreiser & White, 2014; Lai et al., 2015, 2011). In addition, some suggested that genetic protective effects might give females greater abilities to compensate for their autistic difficulties, potentially to the extent of not requiring an autism diagnosis (Dworzynski et al., 2012; Kirkovski et al., 2013).

The concept of varying adaptation to different environments – or variation in the person-environment fit – has been suggested as a fundamental drive of camouflaging behaviours (Lai & Baron-Cohen, 2015; Lai et al., 2015). Individuals who do not feel as though they fit into a social situation, particularly females who feel greater pressure to fit in socially, may attempt to adapt their behaviour in that situation in order to better fit in.

In less-pressured situations, the same individual may not feel any need to adapt or compensate for their behaviours. This may lead to variation in presentation across different environments, for example at home, school, or in clinical assessment, leading to a discrepancy in the perceived extent of autistic social communication difficulties. This may also account for variation in perceived autistic characteristics over time; the complexity of social situations may change across development, such that an autistic individual is able to adapt to or compensate for difficulties in more basic social interactions, but their difficulties may become more apparent as the social environment becomes more complex (Lai et al., 2011; Mandy, Pellicano, St Pourcain, Skuse, & Heron, 2018).

#### 1.5.2 Research into Camouflaging

Summarising the state of research into autism sex/gender differences in 2015, Lai and colleagues (2015) suggested that future research required the thorough operationalisation of camouflaging as well as the development of camouflaging assessment tools. Since then, several researchers have used qualitative methods to explore the concept of camouflaging, and multiple approaches to measuring camouflaging have been developed. One such method, a self-report measure of camouflaging intention, is the focus of Chapter 4 of this thesis and is discussed in Chapters 5-7. Other approaches to measuring camouflaging will be discussed presently.

A number of studies have used qualitative methods to investigate social camouflaging behaviours in autistic girls and women. Interviews with mothers of autistic girls (Cridland, Jones, Caputi, & Magee, 2014) described how some girls mimic their peers' social behaviours and interests, and it was suggested that this may reduce the appearance of autistic characteristics. Tierney, Burns, and Kilbey (2016) interviewed 10 adolescent autistic girls about their experiences of using 'coping strategies', and revealed some common themes including the uncertain, exhausting nature of the social environment; the desire to make friends which motivated camouflaging attempts; and using explicit

techniques to mask autism-related difficulties. Similar themes have also been noted in qualitative interviews with late-diagnosed autistic women (Bargiela et al., 2016), and with autistic young women and their parents (Milner, McIntosh, Colvert, & Happé, 2019; Sedgewick, Hill, & Pellicano, 2018; Sutherland et al., 2017). In particular, the idea of pretending to be normal, which could be achieved through both learned and automatic strategies, and the extensive costs of such strategies, were identified.

Descriptions of camouflaging also emerged through the Europe-wide Autism in Pink project, although these findings have not been published in peer-reviewed journals (Kenyon, 2014). Autistic women from across Europe co-developed a qualitative description of their lives and experiences of autism, which included the concept of camouflaging: “many of the participants go to great lengths to compensate for and cover up some of their autistic characteristics by suppressing them, mimicking other people, and using logic rather than instinct to work out social situations. This means that people are not aware of the difficulties that they might be experiencing, or of the reality of the need for appropriate support. It also means that women with autism are constantly putting a lot of extra energy into their interactions, which is exhausting” (p 5).

Qualitative research before 2017 was focused almost exclusively on the experiences of autistic females. Although one study describing the lived experiences of autistic women (Baldwin & Costley, 2015) included a comparison group of men in the wider sample, only the women’s experiences were qualitatively analysed and reported. The qualitative research described so far identified camouflaging behaviours or experiences in the context of other areas of focus; prior to this thesis there was limited qualitative exploration with camouflaging as the focus of analysis, and no qualitative studies sought to systematically conceptualise camouflaging. Chapter 3 of this thesis addresses this limitation through a large-scale exploratory study designed to conceptualise camouflaging, based on autistic adults’ experiences of camouflaging.

### 1.5.3 Discrepancy approach

Attempts to measure camouflaging have mostly fallen under two different approaches (see Table 1.1 for a summary of the approaches and studies following them). The first focuses on camouflaging as evidenced by the discrepancy between an individual's innate autistic characteristics and their external presentation of autism.

Some researchers have conceptualised camouflaging as the difference between the core difficulties or characteristics associated with autism, and the behavioural presentation of autism in a specific situation (Lai et al., 2017; Livingston & Happé, 2017). This could be described as a 'discrepancy' approach to camouflaging, as it seeks to operationalise the discrepancy between how autistic a person truly is (their internal autistic status), and how autistic they appear to be externally (their external autistic presentation).

Empirical studies using this discrepancy approach (summarised in Table 1.1) have generally found that autistic females have higher camouflaging discrepancy scores than males. For instance, females were found to have a greater discrepancy between self-reported autistic traits and social cognitive abilities, and autistic behaviours as measured by an observer (Lai et al., 2017). This discrepancy was also associated with greater activation of the ventromedial prefrontal cortex in response to self-representation in females only (Lai et al., 2018). A similar result was found by Ratto and colleagues (2017), where autistic females had higher levels of parent-reported autistic traits and poorer adaptive functioning than males, despite being matched on ADOS scores.

Table 1.1. Approaches to measuring camouflaging and studies following these approaches

<b>Approach</b>	<b>Description</b>
Discrepancy	Conceptualises camouflaging as the discrepancy between an individual's internal and external autistic characteristics
	<b>Studies using this approach</b>
	<b>Operationalisation of camouflaging</b>
Lai et al., 2017	Discrepancy between self-reported autistic traits/performance on mentalising task (internal) and ADOS score (external)
Lai et al., 2018	Discrepancy between self-reported autistic traits/performance on mentalising task (internal) and ADOS score (external)
Livingston et al., 2018	Discrepancy between performance on a theory of mind task (internal) and ADOS score (external)
Parish-Morris et al., 2017	Discrepancy between parent-reported autistic traits (internal) and use of typical language techniques (external)
Ratto et al., 2017	Discrepancy between parent-reported autistic traits/adaptive behaviour (internal) and ADOS/ADI-R score (external)
Rynkiewicz et al., 2016	Discrepancy between self/parent-reported autistic traits (internal) and use of gesture (external)
Observational/ Reflective	Conceptualises camouflaging as the specific behaviours and processes (whether conscious or implicit) leading to variation in the behavioural presentation of autism

<b>Studies using this approach</b>	<b>Operationalisation of camouflaging</b>
Cage et al., 2017	Self-reported camouflaging (yes/no)
Cage & Troxel-Whitman, 2019	Score on self-report measure of camouflaging behaviours (CAT-Q).
Cassidy et al., 2018	Score on four self-report questions of camouflaging
Dean et al., 2017	Observed social behaviours in the playground

Note. ADOS = Autism Diagnostic Observation Schedule; ADI-R = Autism Diagnostic Interview – Revised; CAT-Q = Camouflaging Autistic Traits Questionnaire

Other discrepancy approaches have looked at specific characteristics of autistic behavioural expression. For instance, autistic females were found to use more typical patterns of filling pauses in conversation than males of equivalent autistic trait severity (Parish-Morris et al., 2017). Another study found trends towards autistic girls using more gestures than boys, where both genders reported equivalent levels of autistic traits, although this did not reach statistical significance (Rynkiewicz et al., 2016).

These approaches are strengthened by the way in which they operationalise camouflaging; the extent of camouflaging (as measured by numerical discrepancy) can be compared between groups and across studies using different techniques and measuring different behaviours. However, a limitation of the discrepancy approach is that measures of ‘internal’ autistic characteristics are at best proxies for true internal characteristics. There currently exist no reliable biomarkers for autism (American Psychiatric Association, 2013; Loth et al., 2015), and currently used self-report and informant-report measures of autistic characteristics are themselves subject to potential biases or misinterpretation (Kopp & Gillberg, 2011; Kreiser & White, 2014).

Discrepancy approaches seek to measure the impact of camouflaging on external presentation of autism; however, this approach does not account for the impact of unsuccessful camouflaging attempts. Camouflaging strategies, whether conscious or unconscious, may have varying success for different individuals across different situations, and attempts may not be as successful as the individual would wish. Preliminary research into camouflaging suggests that it is associated with poor mental health outcomes, including anxiety, depression, and suicidal thoughts (Cage, Di Monaco, & Newell, 2017; Cage & Troxell-Whitman, 2019; Cassidy, Bradley, Shaw, & Baron-Cohen, 2018; Lai et al., 2017). It therefore seems necessary to measure both camouflaging intention and success, and to be able to separate the two, to understand the full impact of camouflaging across an autistic individual's lifespan.

#### 1.5.4 Observational/reflective approach

An alternative approach to measure camouflaging focuses on the direct identification of camouflaging behaviours through observation and reflection by autistic individuals or others around them. Studies using this approach are summarised in Table 1.1. Extent of camouflaging can therefore be quantified without the need for a measure of internal autistic characteristics, as it is the behaviours themselves rather than the underlying characteristics they might mask which are of interest. Similarly to discrepancy approaches, this allows for comparison across individuals (assuming they use the same methods of observation or reporting), and has the additional strength of allowing measurement of behaviours regardless of how successful they are. In other words, identification of camouflaging is not reliant on either a proxy measure of internal autistic status, or the need to display a typical social presentation.

With regards to gender differences in camouflaging, studies using the observational/reflective approach have yielded inconsistent results. Camouflaging behaviours were observed in autistic girls in the playground, but not autistic boys or typically developing children of either gender (Dean, Harwood, & Kasari, 2017). When



asked to report whether or not they camouflage, no gender differences have been observed in autistic adults (Cage et al., 2017; Cassidy et al., 2018). Self-report measures of camouflaging suggest females have higher total scores (Cassidy et al., 2018), or that there is no difference in total score between males and females (Cage & Troxell-Whitman, 2019). Chapter 5 of this thesis describes another study using an observational/reflective approach to compare self-reported camouflaging in autistic and non-autistic men and women, and gender differences in autistic adolescents are explored in Chapters 6 and 7. As the body of evidence regarding gender differences in camouflaging grows in the future, synthesis and evaluation through meta-analysis across different methodologies will be essential to determine whether or not camouflaging forms part of a female autism phenotype.

This approach to measuring camouflaging has the advantage of allowing for variation in camouflaging behaviours and their success. Techniques learned and used in some situations may not be successful in others, and an individual's overall camouflaging ability may partly depend on their ability to adapt to different situations. The cognitive flexibility enabling this has already been suggested as one explanation for autistic girls' superficially higher social skills (Lehnhardt et al., 2015). However, many of these measures of camouflaging are based on non-autistic observers' ideas of what camouflaging looks like. Intentions and behaviours of camouflaging which clinicians and researchers may not be aware of, but which may form an important part of autistic individuals' camouflaging strategies, have not yet been measured. The current thesis therefore follows an observational/reflective approach by using autistic individuals' own experiences of camouflaging to build a conceptual model and develop a measure of camouflaging in social situations.

## **1.6 Conclusions**

Discrepancies in autism diagnosis between males and females may be due both to reduced likelihood of autism development in females, and under-diagnosis of those

females who are autistic. One explanation for the latter is that some autistic females express their autism through subtle variations in behaviour compared to males, which are not captured in current diagnostic tools or criteria. This chapter summarised some research into the proposed female autism phenotype, and focused on the concept of camouflaging as an increasingly important topic of research in recent years. The included evidence generally supports the existence of a female autism phenotype, which may include differences in social difficulties regarding the maintenance of social relationships; interests which tend to be more relational in nature; and the co-occurrence of internalising disorders. However, further research is necessary to determine whether other behaviours may also comprise the female autism phenotype, and to explore whether these characteristics represent a uniquely female expression of autism, or simply variation from the stereotypical autistic behaviours identified in earlier years. It is also important to determine whether gender differences in these behaviours represent differences across the general population, or are unique to autism.

It is still unclear whether camouflaging forms part of the female autism phenotype. This thesis represents the first attempt to fully conceptualise and measure camouflaging using observational/reflective measures, and to develop a reliable and valid measure of camouflaging. Such a measure can be used to further examine gender differences in camouflaging intention and, through combination with other measures of camouflaging, behavioural presentation or camouflaging success. Extensive validation of this measure, and the construct of camouflaging it operationalises, will enable future research into camouflaging and its implication for the female phenotype to be explored using theoretically and psychometrically rigorous methods.

### **1.7 Aims of this thesis**

1. To develop a conceptual model of camouflaging in autism based on autistic individuals' real-life experiences of camouflaging.
2. To develop a reliable and valid method to measure camouflaging in autistic and non-autistic adults.
3. To examine potential gender differences in camouflaging and consider the role of camouflaging in the female autism phenotype.

## CHAPTER 2: BEHAVIOURAL AND COGNITIVE GENDER DIFFERENCES IN AUTISTIC AND NON-AUTISTIC MALES AND FEMALES (STUDY 1)

### 2.1 Abstract<sup>2</sup>

Camouflaging has been proposed to form part of the female autism phenotype, which may result in underdiagnosis of autistic females. It is first important to define exactly what the female autism phenotype may look like, by comparing behavioural presentations of autism between males and females. However, studies assessing gender differences in autism often fail to include typically developing control groups. It is therefore unclear whether observed gender differences reflect those found in the general population, or are particular to autism and so may reflect a female autism phenotype. A systematic search identified papers comparing behavioural and cognitive characteristics in males and females with and without an autism spectrum disorder (ASD) diagnosis up to September 2015. Thirteen studies were included in meta-analyses of gender differences in core autistic symptoms (social/communication impairments and restrictive/repetitive behaviours & interests) and IQ. Twenty studies were included in a qualitative review of gender differences in additional autistic symptoms. For core traits and IQ, gender differences were comparable in autistic and non-autistic samples. Some additional autistic symptoms displayed different patterns of gender differences in autistic and non-autistic groups, including measures of executive function, empathising and systemising traits, internalising and externalising problems, and play behaviours. The existence of

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<sup>2</sup> Citation for the published, peer-reviewed journal article for this chapter:

Hull, Mandy & Petrides (2017). Behavioural and cognitive sex/gender differences in Autism Spectrum Condition and typically developing males and females. *Autism*, 21(6), 706-727. See Appendix 11 for the accepted version of the article.

some female-specific expressions of autism justifies the further exploration of camouflaging as part of the female autism phenotype.

## **2.2 Introduction**

### **2.2.1 Gender Differences in Autism**

There have been several reviews of the literature on gender differences in the core autistic characteristics of social/communication impairments and restricted/repetitive behaviours and interests (RRBIs). These generally conclude that autistic females may display a different phenotype, or different pattern of autistic characteristics, to males (Kirkovski et al., 2013; van Wijngaarden-Cremers et al., 2014). While specific gender differences in the severity of social and communication impairments have not been conclusively demonstrated (Koenig & Tsatsanis, 2005; Lai et al., 2011, 2012; Lai, Lombardo, Auyeung, Chakrabarti, & Baron-Cohen, 2015; van Wijngaarden-Cremers et al., 2014), some have found that autistic girls and women, on average, display fewer RRBIs (Koenig & Tsatsanis, 2005; Kreiser & White, 2014; Rivet & Matson, 2011). However, it has been argued that RRB diagnostic criteria fail to reflect the true range of areas under which RRBIs can fall (Mandy et al., 2012). It is possible that many autistic females experience very extreme interests or behavioural tendencies, but in areas outside the 'typical' autistic interests of systems and machines, therefore excluding them from meeting diagnostic criteria for RRBIs in ASD (American Psychiatric Association, 2013).

Reviews have also addressed gender differences in additional symptoms associated with autism, such as internalising and externalising problems and the co-diagnoses that may result from these. Autistic males, and males with high autism traits but no clinical diagnosis of autism, are more likely to experience externalising problems such as behavioural problems and hyperactivity, while females are more likely to experience internalising problems such as depression and anxiety hyperactivity (Koenig & Tsatsanis, 2005; Kreiser & White, 2014; Rivet & Matson, 2011). This suggests that the

pattern of behaviours associated with autistic characteristics varies between males and females, which may require adjustment of current diagnostic criteria.

### 2.2.2 Gender Differences and Diagnosis

As discussed in Chapter 1, there is evidence that females are less likely than males to receive a diagnosis of autism. One explanation for this is that females may present their autistic characteristics in subtly different ways to males, ways which are not identified using current diagnostic criteria (Kirkovski et al., 2013; Lai et al., 2011).

If this is the case, it would suggest that ASD diagnostic criteria and thresholds should vary for males and females, to ensure that all individuals are able to access the services and support they require. However, the precise ways in which diagnostic criteria might be adapted depend on exactly how and why autistic males and females differ. One issue with previous research into gender differences in autism is that typical gender differences have rarely been taken into account. This means that we cannot be certain whether autistic males and females differ in the same ways that typically developing males and females differ, or whether having autism has a differential impact on males and females, and it is this that produces the gender differences described above.

If the first prediction is borne out, then the performance of autistic males and females on diagnostic criteria should also be compared to that of typically developing males and females respectively. Gender differences (or lack thereof) in typically developing populations have been established for a wide range of behaviours related to autism, therefore it stands to reason that autistic males should be compared to typically developing males, and autistic females to typically developing females when assessing strengths and impairments.

If, on the other hand, autism does produce different outcomes for males and females beyond those attributed to typical gender differences, adjustments to diagnostic criteria are less straightforward. One outcome might be the development of separate diagnostic

criteria for males and females, reflecting differential presentations of autism in each gender in at least some areas.

Thus, it is important to compare gender differences in the autistic population with those in typically developing groups, in order to establish whether autism interacts with an individual's gender to produce different outcomes, or whether typical gender differences also exist within in the autistic population. This then has implications for adjustments to diagnostic criteria, and for a broader conceptualisation of autism in males and females.

This review aims to address the following questions:

What are the gender differences in autistic core and associated symptoms (if any), for autistic and typically developing groups?

Do these gender differences vary between autistic and typically developing groups? In other words, is there an interaction between gender and autism diagnosis?

## **2.3 Methods**

### **2.3.1 Literature Review**

A search of the Psych Info, Pub Med, and Web of Science directories in September 2015 for the terms “autism + sex differences” and “autism + gender differences” produced 3290 initial results. Figure 2.1 describes the logic used to select studies for inclusion. Eligibility criteria were peer-reviewed papers published in English and comparing males and females with and without an ASD diagnosis (including Autism, Autism Spectrum Disorder, Asperger's Syndrome, and Pervasive Developmental Disorder Not Otherwise Specified [PDD-NOS]), which matched autistic and typically developing groups for IQ and age. Bibliographies of relevant papers, including those of seven recent review and/or meta-analysis papers, were manually searched to find additional papers which may have been missed in the initial search (n = 37). Studies were excluded (n = 3307) if they were duplicates, if they only measured biological gender differences, and if they did not include groups of males and females with and without an ASD diagnosis, matched on age and IQ.

Twenty original studies were selected for inclusion in the review of variation in gender differences between autistic and typically developing groups. See Tables 2.1 and 2.2 (Appendices 1 and 2) for information about all 20 studies, including summaries of their findings and characteristics of the samples used. Where multiple comparison groups were included, the group most similar to an unrelated, general population sample was selected for inclusion in this review. Several additional authors were contacted to request data on control groups for inclusion in the analysis, but none were able to provide complete datasets. Due to the limited number of eligible studies, meta-analysis of autistic and non-autistic gender differences was only possible for six studies measuring social/communication impairments, five studies measuring RRBIs, and 13 studies measuring IQ.



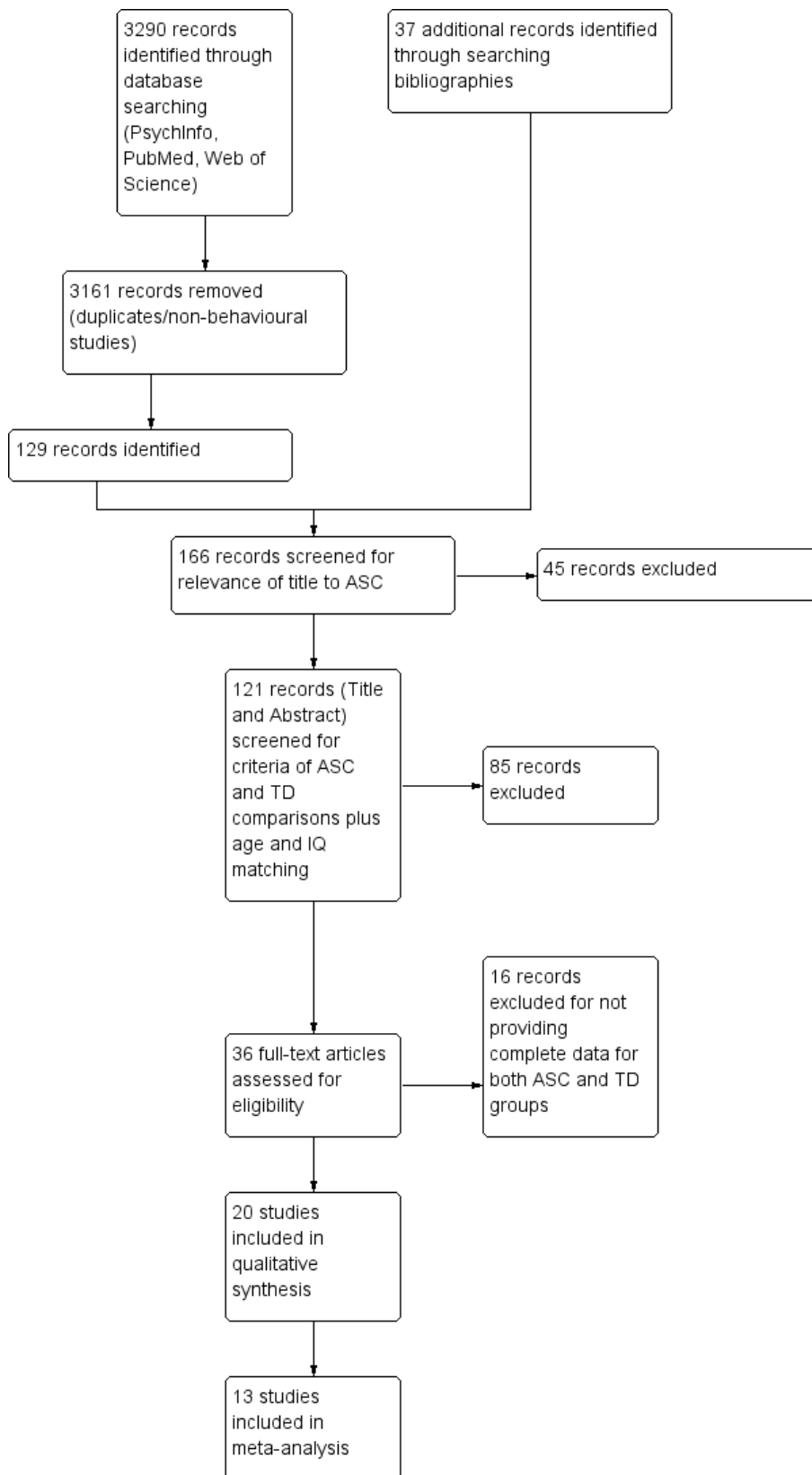


Figure 2.1. Flow diagram showing identification and selection of studies for inclusion in the review and meta-analysis. ASC = Autism Spectrum Conditions; TD = typically developing.

### 2.3.2 Statistical Analysis

Random-effects meta-analyses were performed using the 'metafor' package in R (R Core Team, 2013; Viechtbauer, 2010) for measures of the core autism symptoms and IQ. Using a random-effects model accounts for variance between studies caused by sampling error and other artefacts (Hunter & Schmidt, 2004). Mean gender differences in Social/Communication impairments (see Table 2.3), Restrictive/Repetitive Behaviours and Interests (see Table 2.4), and IQ (see Table 2.5) were calculated for autistic and non-autistic groups, then standardised mean differences (SMD) between these differences were calculated, to take into account the variety of test instruments used. Social and communication impairments were analysed separately due to some studies testing these separately or only testing one of these, but are presented and discussed together, to reflect the fact that these autistic symptoms are treated as a unitary domain in DSM-5. Where tests for heterogeneity were significant, a mixed-effects model was used to test for the effect of the moderator 'Age' (Age of participants). Autistic groups were entered into the analysis first, therefore positive effect sizes would mean greater gender differences in autistic groups than typical groups, and negative effects sizes would mean smaller gender differences in autistic groups. Where multiple measures of the same symptom were used within one study, the measure most similar to those used in other studies was selected for inclusion in this analysis.

## 2.4 Results

### 2.4.1 Meta-Analysis

Figure 2.2 presents the funnel plots for each of the four meta-analyses conducted. Due to the limited number of studies, it is difficult to draw conclusions about publication bias. However, three of the four plots show some asymmetry, with a positive skew, suggesting there may have been some publication bias in favour of studies reporting statistically significant gender differences in ASD populations. Despite this, Hunter and Schmidt (2004) note that studies of gender difference may be less susceptible to availability bias (the suggestion that studies with significant findings and large effect sizes are more likely

to be published, and therefore more available for inclusion in meta-analyses) than other studies. This is because the gender difference is usually a supplementary analysis to the research question of interest and so publication is less likely to be dependent on satisfactory gender difference results.

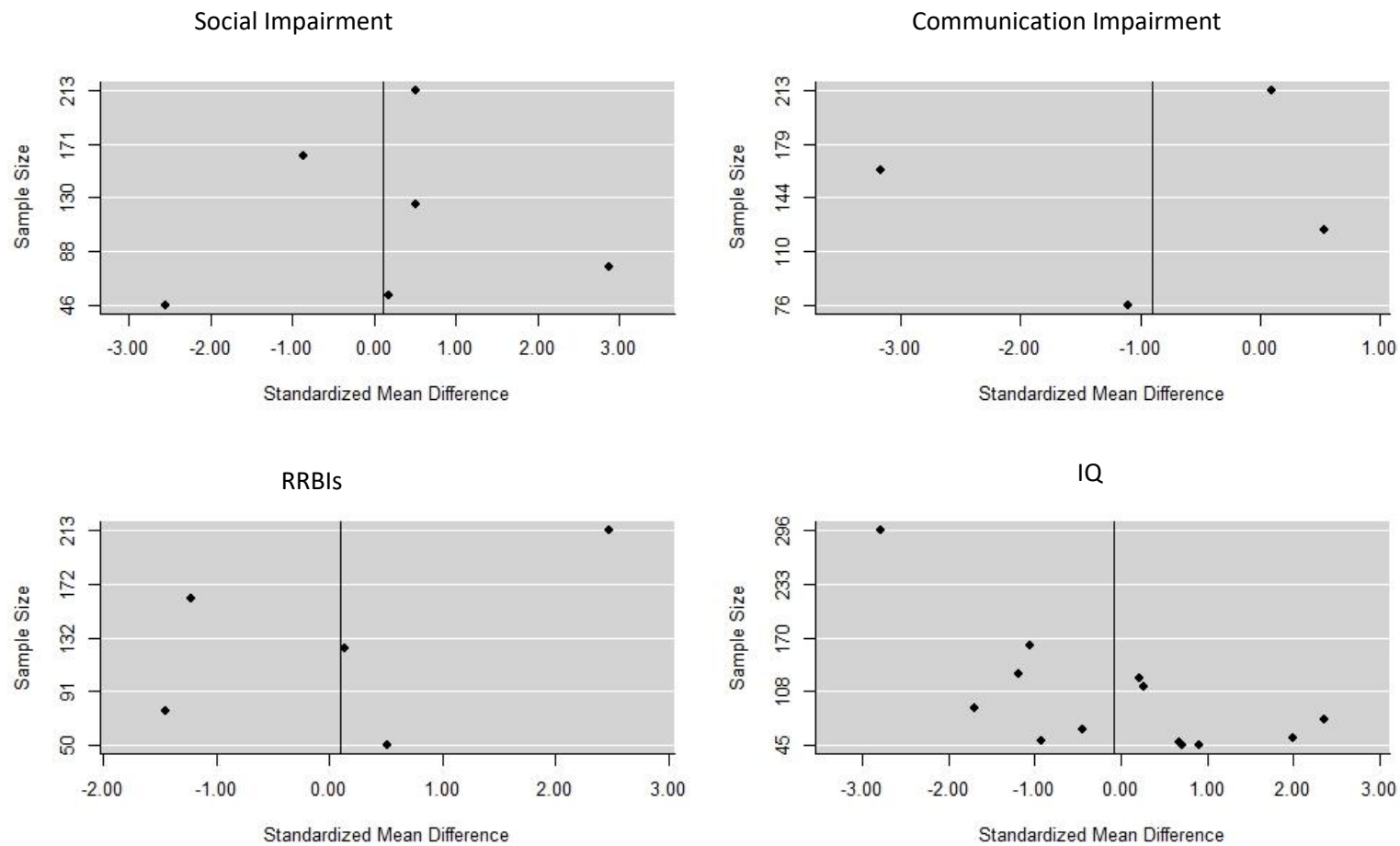


Figure 2.2. Funnel plot of studies included in meta-analysis of gender differences in autistic and typically developing populations. Studies compared social impairments (n = 6), communication impairments (n = 4), restricted/repetitive behaviours and interests (n = 5) and IQ (n = 13).

#### 2.4.1.2 Social and Communication impairments.

Table 2.3 displays the mean scores, test used, and gender differences in social and communication impairments for autistic and non-autistic groups. Random-effects meta-analysis found no significant differences between social impairments for autistic males or females across studies,  $SMD = -0.21$ , 95% CI [-0.44, 0.02]. Typically developing females were found to have significantly lower levels of social impairments than males,  $SMD = -0.23$ , 95% CI [-0.42, -0.04]. Nevertheless, a random-effects meta-analysis revealed no significant difference in the effect of gender between the autistic and non-autistic groups.

Table 2.3. Gender differences in social and communication impairments for Autism Spectrum Disorder (ASD) and typically developing (TD) groups

**Social Impairments**

Authors (date)	Test used	Age of participants	ASC			TD		
			Female (SD)	Male (SD)	SMD [95% CI]	Female (SD)	Male (SD)	SMD [95% CI]
Kirkovski et al. (2016)	RAADS-R	Adult	28.36	28.77	-0.03	3.92	4.36	-0.10
	Social Relatedness subscale		(13.87)	(13.80)	[-0.78, 0.73]	(4.01)	(4.61)	[-0.87, 0.67]
May, Cornish & Rinehart (2012)	SRS	Child	97.41 (31.77)	99.97 (22.71)	-0.09 [-0.58, 0.40]	23.17 (16.49)	27.30 (20.42)	-0.22 [-0.73, 0.29]
Park et al. (2012)	ADI-R social subscale	Child	8.55 (4.43)	10.25 (3.83)	-0.43 [-0.92, 0.06]	1.00 (1.22)	1.28 (1.46)	-0.20 [-0.76, 0.35]
Sedgewick et al. (2015)	SRS	Adolescent	72.00 (32.39)	103.00 (27.76)	-0.98 [-1.85, -0.11]	43.00 (13.18)	40.00 (26.16)	0.15 [-0.68, 0.97]

Authors (date)	Test used	Age of participants	ASC			TD		
			Female	Male	SMD	Female	Male	SMD
			(SD)	(SD)	[95% CI]	(SD)	(SD)	[95% CI]
Solomon et al. (2012)	SRS	Child/ Adolescent	103.85 (27.64)	104.60 (32.04)	-0.02 [-0.64, 0.60]	18.11 (18.79)	62.81 (60.81)	-1.00 [-1.69, -0.30]
Zwaigenbaum et al. (2012)	ADI-R social subscale	Child	10.75 (7.00)	11.30 (5.90)	-0.09 [-0.54, 0.37]	2.25 (2.34)	2.70 (2.66)	-0.18 [-0.44, 0.08]

**Communication Impairments**

Authors (date)	Test used	Age of participants	ASC			TD		
			Female	Male	SMD	Female	Male	SMD
			(SD)	(SD)	[95% CI]	(SD)	(SD)	[95% CI]
May, Cornish & Rinehart (2012)	CCC – global communication subscale	Child	36.75 (15.05)	33.19 (16.00)	0.23 [-0.26, 0.72]	80.60 (22.94)	78.63 (19.78)	0.09 [-0.42, 0.60]

Authors (date)	Test used	Age of participants	ASC			TD		
			Female	Male	SMD	Female	Male	SMD
			(SD)	(SD)	[95% CI]	(SD)	(SD)	[95% CI]
Park et al. (2012)	ADI-R nonverbal communication subscale	Child	17.75 (8.20)	22.31 (6.16)	-0.69 [-1.18, -0.20]	1.80 (2.33)	1.50 (1.90)	0.14 [-0.41, .69]
Solomon et al. (2012)	CCC – global communication Subscale	Child/ Adolescent	76.00 (14.93)	80.95 (24.55)	-0.24 [-0.86, 0.38]	113.05 (16.20)	111.00 (16.37)	0.12 [-0.53, 0.78]
Zwaigenbaum et al. (2012)	ADI-R communication subscale	Child	8.71 (4.54)	10.09 (3.61)	-0.35 [-0.80, 0.11]	1.71 (2.14)	2.85 (2.86)	-0.45 [-0.71, -0.19]

*Note.* SD = Standard Deviation; SMD = Standardised Mean Difference; CI = confidence interval; SRS = Social Responsiveness Scale; ADI-R = Autism Diagnostic Interview – Revised; RAADS-R = Ritvo Autism and Asperger’s Diagnostic Scale—Revised; CCC = Child Communication Checklist; ADI-R = Autism Diagnostic Interview – Revised



Significant heterogeneity was found in this analysis ( $Q = 158.76, p < .001$ ), therefore the moderator Age was included in the model and found to be significant,  $QM (df = 4) = 20.53, p < .001$ . The resulting mixed-effects meta-analysis (see Figure 2.3) found significant variation in gender differences for social impairment between autistic and non-autistic groups for studies including adolescents ( $n = 2$ ). However, these two studies found different patterns of variation, with the study by Sedgewick et al. (2015) finding smaller gender differences in autistic adolescents than non-autistic, and the study by Solomon et al. (2012) finding the opposite effect. In those studies which only included children or adults ( $n = 4$ ), no significant variation in gender differences between autistic and non-autistic groups was found. However, the test for residual heterogeneity was significant,  $QE (df = 2) = 43.19, p < .001$ , indicating that other moderators, not included in the model, may still be influencing the effect of gender.

Social Impairment

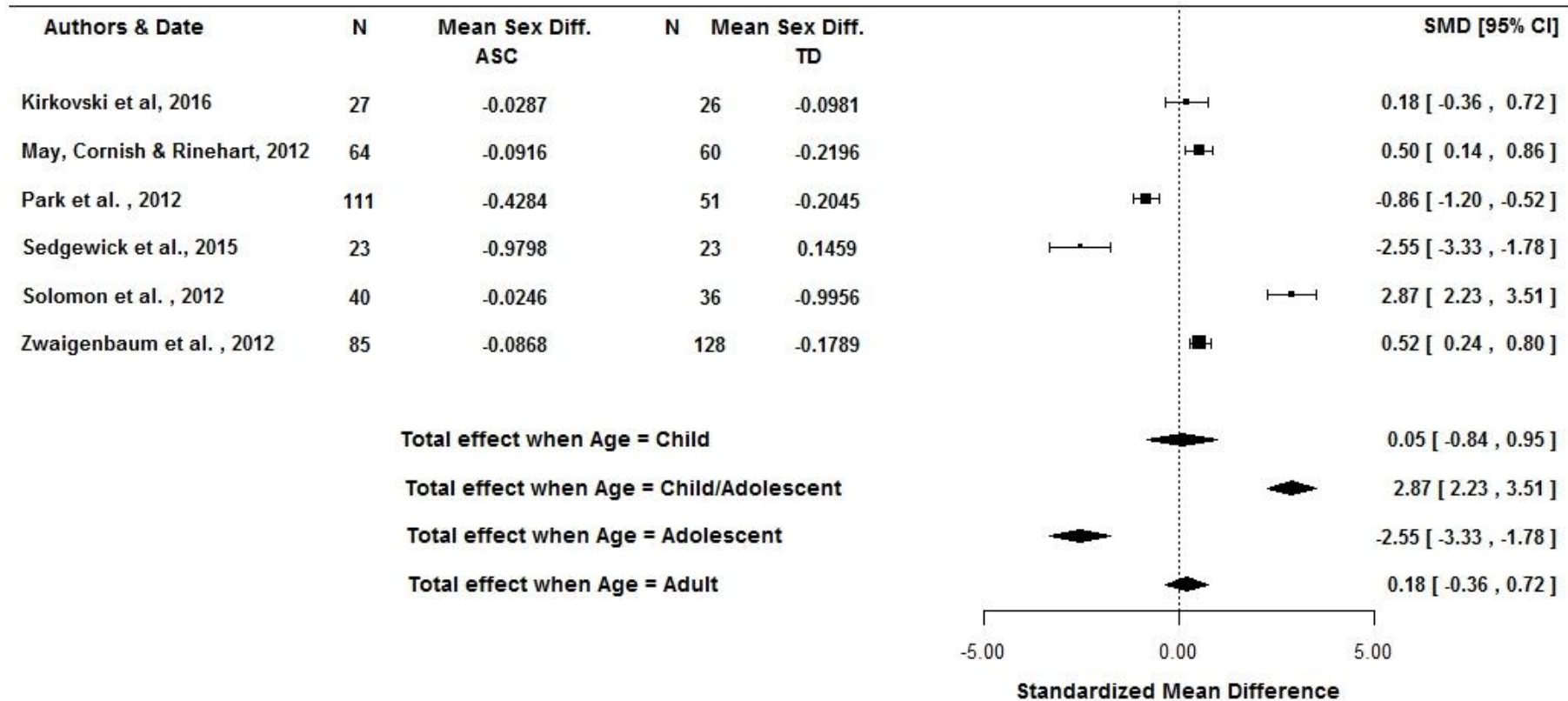


Figure 2.3. Forest plot of standardised mean differences (SMD) for social impairment in each study and total SMD at each level of moderator 'Age', drawn in R using 'metafor' package (Viechtbauer, 2010; R Foundation for Statistical Computing, Vienna, Austria). Central rectangle indicates mean effect; lines indicate 95% confidence intervals. Negative effects indicate smaller gender differences in ASD groups than in TD groups; positive effects indicate larger gender differences in ASD groups than in TD groups. If lines cross the y axis, effect is not significant. Rectangles indicate the effect size (SMD) in each study, with the size of the rectangle indicating the 'weight' of the study (determined by the sample size and the precision of the confidence intervals). Diamonds indicate the average effect size in each group of studies, wider diamonds indicating wider confidence intervals of the effect. ASD = Autism Spectrum Disorder group; TD = typically developing group; CI = confidence interval.

No significant difference in communication impairments was found using meta-analysis for autistic males and females,  $SMD = -0.26$ , 95% CI [-0.65, 0.12], or typically developing males and females,  $SMD = -0.09$ , 95% CI [-0.44, 0.26]. A random-effects meta-analysis ( $n = 4$ ) revealed no significant difference in the effect of gender for the autistic or non-autistic groups,  $SMD = -0.90$ , 95% CI [-2.52, 0.72]; Figure 2.4. Significant heterogeneity was found in this analysis ( $Q = 174.91$ ,  $p < .001$ ), therefore, the moderator Age was included in the model but was not found to be significant,  $QM (df = 1) = 0.01$ ,  $p = .91$ . In contrast, the test for residual heterogeneity was significant,  $QE (df = 2) = 166.56$ ,  $p < .001$ , indicating that other moderators not included in the model may still be influencing the effect of gender.

Communication Impairment

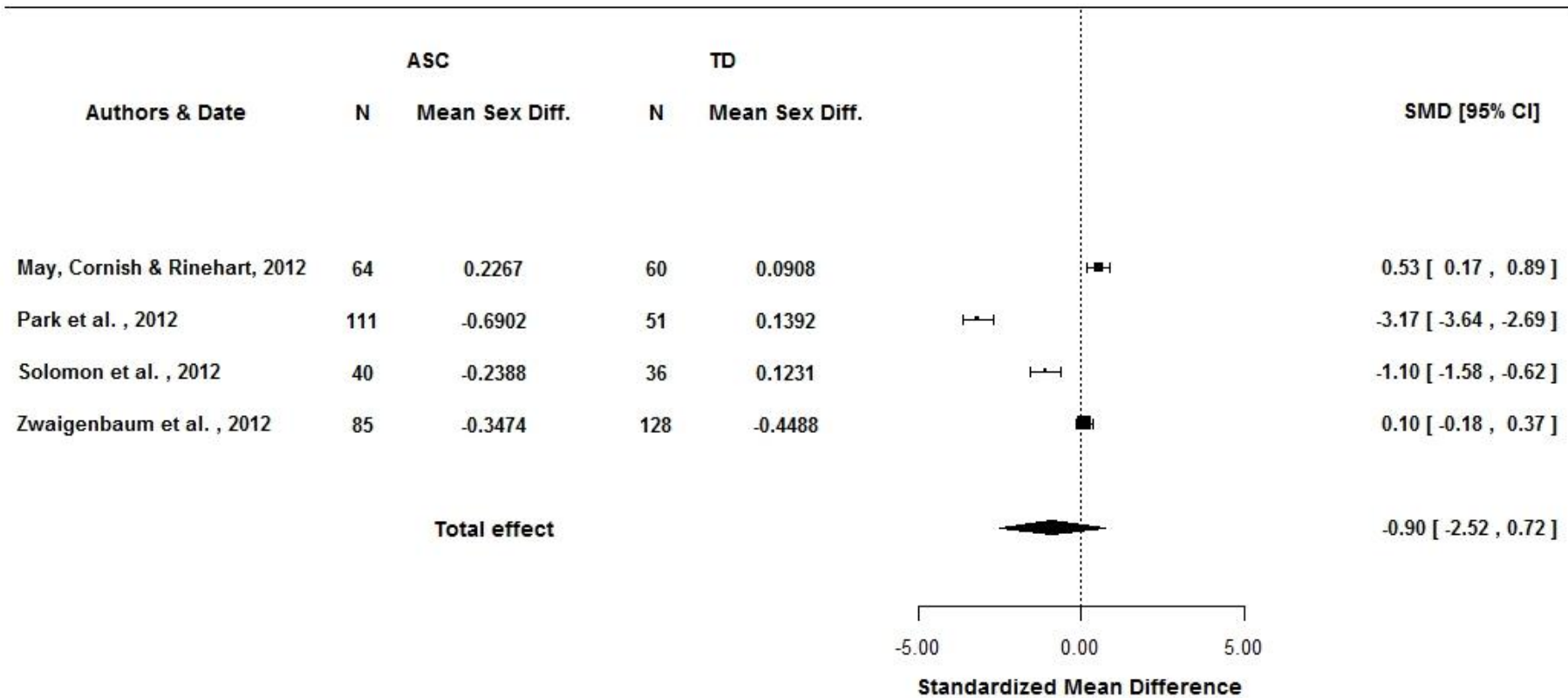


Figure 2.4. Forest plot of standardised mean differences (SMD) for communication impairment in each study and total SMD from all studies, drawn in R using ‘metafor’ package (Viechtbauer, 2010; R Foundation for Statistical Computing, Vienna, Austria). Central rectangle indicates mean effect; lines indicate 95% confidence intervals. Negative effects indicate smaller gender differences in ASD groups than in TD groups; positive effects indicate larger gender differences in ASD groups than in TD groups. If lines cross the y axis, effect is not significant. Rectangles indicate the effect size (SMD) in each study, with the width of the rectangle indicating the ‘weight’ of the study (determined by the sample size and the precision of the confidence intervals). The diamond indicates the average effect across all studies, with the width of the diamond indicating the confidence intervals of the effect. ASD = Autism Spectrum Disorder group; TD = typically developing group; CI = confidence interval.

#### 2.4.1.2 Restrictive/Repetitive Behaviours and Interests (RRBIs).

Table 2.4 displays the mean scores, test used, and gender differences for ASD and TD groups. The extent of RRBIs was not significantly different between autistic males and females,  $SMD = -0.30$ , 95% CI [-0.66, 0.07]. Typically developing females had significantly lower levels of RRBIs than typically developing males,  $SMD = -0.29$ , 95% CI [-0.49, -0.09]. A random-effects meta-analysis ( $n = 5$ ) revealed no significant difference in the effect of gender for the autistic and non-autistic groups,  $SMD = 0.09$ , 95% CI [-1.30, 1.48; see Figure 2.5]. Significant heterogeneity was found in this analysis ( $Q = 255.24$ ,  $p < .001$ ), therefore the moderator Age was included in the analysis. However, omnibus testing revealed no significant effect of Age,  $QM (df = 1) = 0.71$ ,  $p = .40$ . In contrast, the test for residual heterogeneity was significant,  $QE (df = 3) = 225.11$ ,  $p < .001$ , indicating that other moderators not included in the model may still be influencing the effect of gender.

Table 2.4. Gender differences in Restrictive/Repetitive Behaviours and Interests (RRBIs) for ASD and TD groups

Authors (date)	Test used	Age of participants	ASD			TD		
			Female (SD)	Male (SD)	SMD [95% CI]	Female (SD)	Male (SD)	SMD [95% CI]
Kirkovski et al. (2016)	RAADS-R Circumscribed Interests	Adult	53.79 (21.67)	57.00 (12.85)	-0.17 [-0.93, 0.58]	8.42 (5.84)	12.09 (12.00)	-0.38 [-1.21, 0.45]
May, Cornish & Rinehart (2012)	RBQ	Child	35.48 (31.77)	38.34 (9.01)	-0.12 [-0.61, 0.37]	23.23 (4.52)	23.86 (3.42)	-0.16 [-0.66, 0.35]
Park et al. (2012)	ADI-R RSB subscale	Child	4.10 (2.51)	5.48 (2.79)	-0.50 [-0.99, -0.01]	0.36 (0.70)	0.50 (0.81)	-0.18 [-0.73, 0.37]
Solomon et al. (2012)	RBS	Child/ Adolescent	2.47 (1.77)	5.00 (3.16)	-0.97 [-1.62, -0.31]	0.00 (0.00)	0.41 (1.23)	-0.48 [-1.14, 0.19]
Zwaigenbaum et al. (2012)	ADI-R RSB subscale	Child	4.43 (2.60)	4.07 (2.68)	0.13 [-0.32, 0.59]	0.74 (1.26)	1.21 (1.74)	-0.31 [-0.57, -0.05]

Note: CI = confidence interval; RBQ = Repetitive Behaviours Questionnaire; RBS = Repetitive Behaviours Scale; ADI-R = Autism Diagnostic Interview – Revised; RAADS-R = Ritvo Autism and Asperger’s Diagnostic Scale—Revised

RRBIs

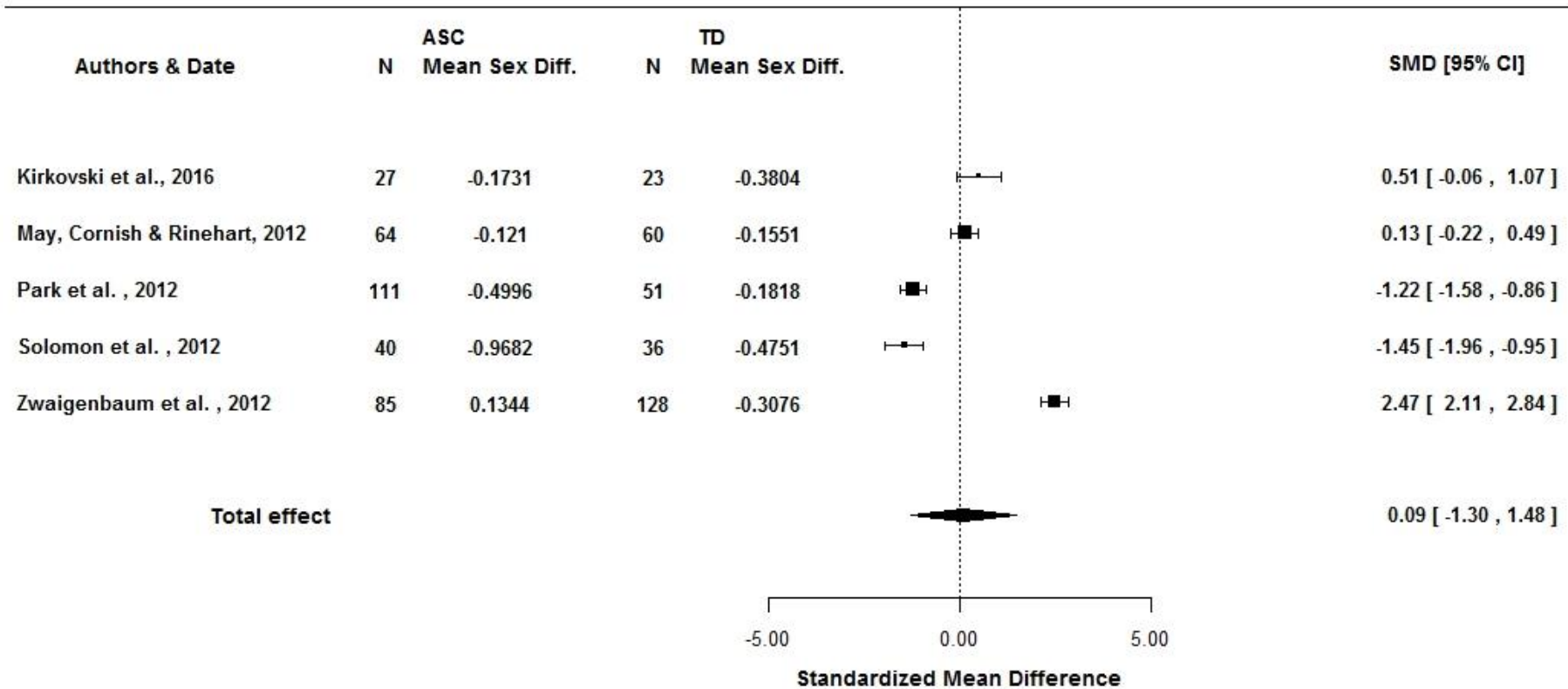


Figure 2.5. Forest plot of standardised mean differences (SMD) for RRBIs in each study and total SMD from all studies, drawn in R using ‘metafor’ package (Viechtbauer, 2010; R Foundation for Statistical Computing, Vienna, Austria). Central rectangle indicates mean effect; lines indicate 95% confidence intervals. Negative effects indicate smaller gender differences in ASD groups than in TD groups; positive effects indicate larger gender differences in ASD groups than in TD groups. If lines cross the y axis, effect is not significant. Rectangles indicate the effect size (SMD) in each study, with the size of the rectangle indicating the ‘weight’ of the study (determined by the sample size and the precision of the confidence intervals). The diamond indicates the average effect across all studies, with the width of the diamond indicating the confidence intervals of the effect. ASD = Autism Spectrum Disorder group; TD = typically developing group; CI = confidence interval.

### 2.4.1.3 IQ.

Table 2.5 displays the mean scores, test used, and gender differences for ASD and TD groups. There were no significant differences between autistic male and female IQ scores,  $SMD = -0.05$ , 95% CI [-0.22, 0.12], or typically developing male and female IQ scores,  $SMD = 0.02$ , 95% CI [-0.17, 0.21]. A random effects meta-analysis ( $n = 13$ ) revealed no significant difference in the effect of gender for the autistic vs. non-autistic groups,  $SMD = -0.09$ , 95% CI [-0.88, 0.71; see Figure 2.6]. Significant heterogeneity was found ( $Q = 453.68$ ,  $p < .001$ ), therefore the moderator Age was included in a mixed-effects meta-analysis but was not found to be a significant moderator,  $QM(df = 1) = 2.45$ ,  $p = .12$ . The test for residual heterogeneity was significant,  $QE(df = 11) = 399.72$ ,  $p < .001$ , indicating that other moderators not included in the model may still be influencing the effect of gender.



Table 2.5. Gender differences in IQ for ASD and TD groups

Authors (date)	Test used	Age of participants	ASD			TD		
			Female (SD)	Male (SD)	SMD [95% CI]	Female (SD)	Male (SD)	SMD [95% CI]
Bolte, Duketis, Poustka & Holtmann (2011)	WISC Non-Verbal IQ	Child/ Adolescent	98.60 (9.80)	99.80 (11.30)	-0.11 [-0.65, 0.43]	102.30 (12.80)	104.70 (13.30)	-0.18 [-0.71, 0.35]
Goddard, Dritschel & Howlin (2014)	Wechsler Full-Scale IQ	Child/ Adolescent	107.40 (13.50)	104.30 (12.40)	0.23 [-0.57, 1.03]	106.00 (11.10)	106.60 (11.20)	-0.05 [-0.85, 0.75]
Harrop, Green & Hudry (2016)	MSEL	Child	27.12 (10.27)	27.20 (10.92)	0.91 [0.13, 1.69]	23.35 (7.86)	22.50 (8.05)	0.10 [-0.67, 0.87]
Holt et al. (2014)	Wechsler Full-Scale IQ	Adolescent	96.44 (11.68)	108.42 (19.47)	-0.68 [-1.29, -0.07]	110.55 (12.66)	112.30 (11.57)	-0.14 [-0.76, 0.48]
Kirkovski et al. (2016)	KBIT-2	Adult	107 (14.48)	112.08 (14.37)	-0.34 [-1.10, 0.42]	113.00 (11.71)	112.45 (16.20)	0.04 [-0.78, 0.86]

Authors (date)	Test used	Age of participants	ASD			TD		
			Female (SD)	Male (SD)	SMD [95% CI]	Female (SD)	Male (SD)	SMD [95% CI]
Lai et al. (2012)	Wechsler Full-Scale IQ	Adult	114.10 (15.50)	113.70 (15.10)	0.03 [-0.46, 0.52]	119.70 (8.40)	116.30 (11.80)	0.33 [-0.17, 0.82]
Lemon, Gargaro, Enticott & Rinehart (2011)	Wechsler Full-Scale IQ	Child/ Adolescent	97.30 (16.74)	91.68 (18.40)	0.31 [-0.52, 1.14]	107.00 (10.72)	108.00 (11.00)	-0.09 [-0.96, 0.78]
May, Cornish & Rinehart (2012)	Wechsler Full-Scale IQ	Child	96.19 (12.62)	97.38 (9.01)	-0.11 [-0.60, 0.38]	106.50 (11.25)	108.43 (11.99)	-0.16 [-0.67, 0.34]
Oswald et al. (2016)	KBIT-2	Adolescent	107.64 (18.13)	112.11 (11.67)	-0.29 [-1.00, 0.41]	108.79 (16.80)	110.61 (10.60)	-0.13 [-0.83, 0.57]
Park et al. (2012)	LIPS	Child	92.00 (25.61)	93.34 (23.67)	-0.06 [-0.54, 0.43]	123.96 (11.37)	121.68 (9.11)	0.22 [-0.33, 0.77]
Sedgewick et al. (2015)	Wechsler Full-Scale IQ	Adolescent	81.17	78.40	0.31	76.54	76.54	0.00

			(11.50)	(11.26)	[-0.52, 1.13]	(10.25)	(10.25)	[-0.82, 0.82]
Authors (date)	Test used	Age of participants	ASD			TD		
			Female (SD)	Male (SD)	SMD [95% CI]	Female (SD)	Male (SD)	SMD [95% CI]
Solomon et al. (2012)	Wechsler Full-Scale IQ	Child/ Adolescent	104.20 (15.29)	103.95 (16.87)	0.02 [-0.60, 0.64]	113.26 (10.23)	121.65 (11.01)	-0.77 [-1.45, -0.10]
Zwaigenbaum et al. (2012)	Mullen – Receptive Language Subscale	Child	40.20 (13.00)	41.90 (13.40)	-0.13 [-0.60, 0.35]	55.00 (9.60)	51.50 (10.50)	0.35 [0.09, 0.61]

Note. CI = confidence interval; WISC = Wechsler Intelligence Scales for Children; LIPS = Leiter International Performance Scale; KBIT-2 = Kaufman Brief Intelligence Test – Second Edition; MSEL = Mullen Scales of Early Learning

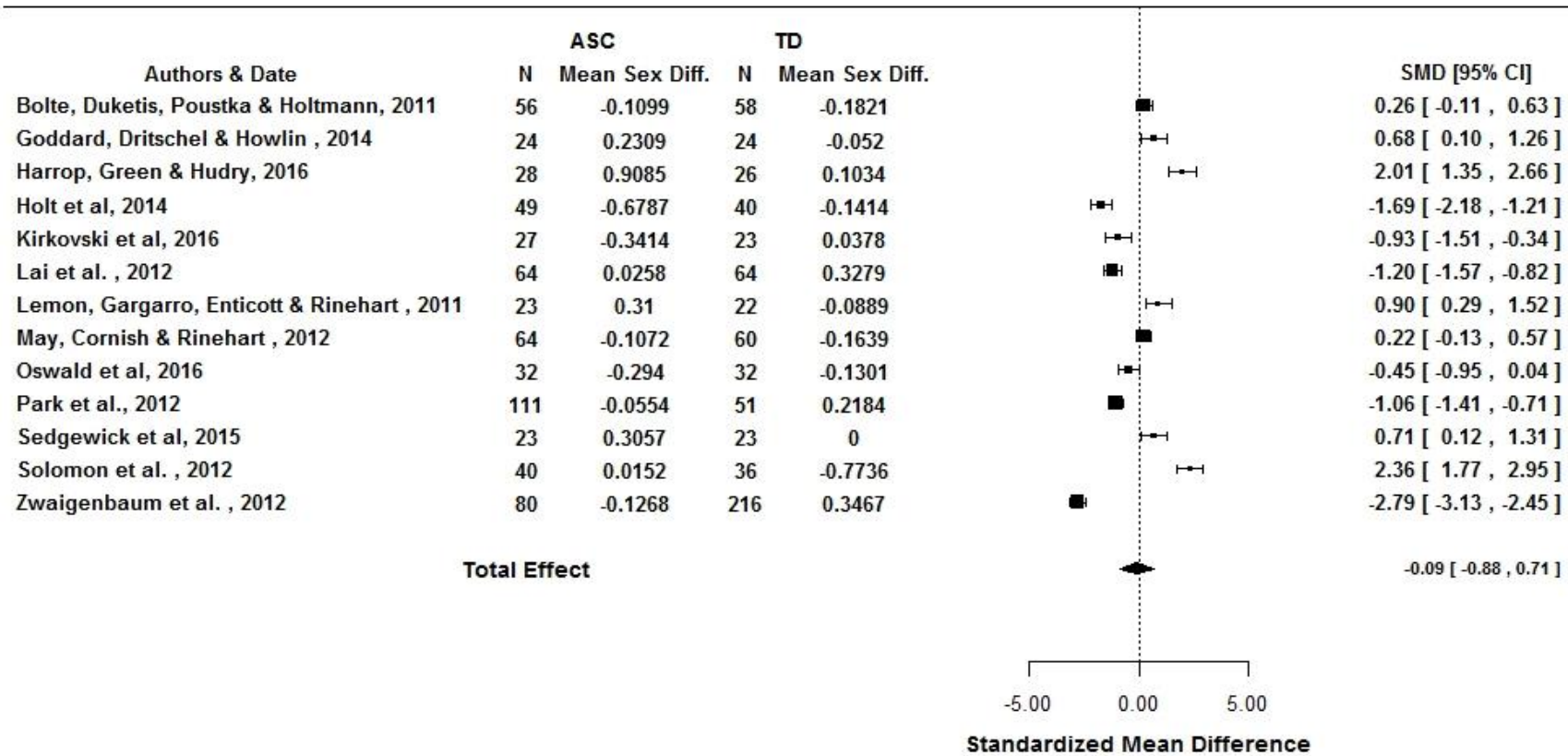


Figure 2.6. Forest plot of standardised mean differences (SMD) for IQ in each study and total SMD at each level of moderator ‘Age’, drawn in R using ‘metafor’ package (Viechtbauer, 2010; R Foundation for Statistical Computing, Vienna, Austria). Central rectangle indicates mean effect; lines indicate 95% confidence intervals. Negative effects indicate smaller gender differences in ASD groups than in TD groups; positive effects indicate larger gender differences in ASD groups than in TD groups. If lines cross the y axis, effect is not significant. Rectangles indicate the effect size (SMD) in each study, with the size of the rectangle indicating the ‘weight’ of the study (determined by the sample size and the precision of the confidence intervals). The diamond indicates the average effect across all studies, with the width of the diamond indicating the confidence intervals of the effect. ASD = Autism Spectrum Disorder group; TD = typically developing group; CI = confidence interval.

## 2.4.2 Systematic Qualitative Review

### 2.4.2.1 Executive Functioning

Executive functions are a set of abilities which facilitate higher-level cognitive control of behaviour, self-monitoring, and future planning, amongst other tasks (Ozonoff & Jensen, 1999). Autistic individuals are often reported to have lower levels of executive functions than typically developing individuals (Happé, Booth, Charlton, & Hughes, 2006). There are contradictions in the literature when it comes to performance on specific tasks of executive functioning. All studies examined here found that as a group, autistic individuals performed more poorly than typically developing individuals. No statistically significant interaction between gender and diagnosis, was found in the Wisconsin Card Sorting Test or the Tower of Hanoi (Bölte, Duketis, Poustka & Holtmann, 2011), or the Go/No-Go task (Lai et al., 2012), suggesting that gender differences may not vary between autistic and non-autistic groups (see Table 2.2). Both studies had medium sample sizes with relatively high proportions of females in each group (compared to many studies examining gender differences in autism), but had limited power to detect small effect sizes, therefore it is possible that significant interactions were in fact undetected in these studies.

In contrast, the Trail-Making Test was found to produce significantly different gender-relative performances depending on diagnostic status. In the autistic group, males had significantly longer reaction times than females, but in the typically developing group, females took longer to complete the task than males (Bölte et al., 2011). With regards to the Stop task, Lemon et al. (2011) found that autistic females demonstrated significantly longer reaction times than autistic males or typically developing females, while no differences were found between autistic males' and typically developing males' performance on this task (see Table 2.2).

### 2.4.2.2 Attention to Detail

Some theories of autism propose that autistic individuals have a bottom-up, centrally focused processing style as opposed to the typically developing top-down, holistic processing style (Happé & Frith, 2006). Bölte and colleagues (2011) found no significant interaction between gender and diagnosis for the Embedded Figures task (EFT), although a marginal interaction was found by Lai et al. (2012). In the latter study, autistic males demonstrated poorer performance on the EFT than typically developing males, while no differences were found between autistic and typically developing females. As above, it is possible that small effect sizes went undetected in these studies. However, a significant gender and diagnosis interaction was found on the Block Design task (see Table 2.2). Autistic males performed better than autistic females, whereas the reverse pattern was found for typically developing individuals (Bölte et al., 2011).

#### 2.4.2.3 Theory of Mind/Emotion Recognition

The ability to infer the content of others' mental and emotional states, regardless of whether they are different to one's own, is known as theory of mind. Late or incomplete development of theory of mind abilities is considered a hallmark of ASC (Baron-Cohen, Leslie, & Frith, 1985), with some individuals failing to achieve 'simple' theory of mind abilities, such as recognising emotional expressions, and others struggling only with more complex tests, such as dynamic interactions (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997).

No significant gender and diagnosis interaction was found for either the Reading the Mind in the Eyes task (RMET) or the Karolinska Directed Emotional Faces task (Holt et al., 2014; Lai et al., 2012; see Table 2.2). However, post-hoc analyses by Holt and colleagues (2014) revealed that autistic males performed more poorly than typically developing males on the RMET, whereas no significant differences were found between autistic and typically developing females. Again, it should be noted that both studies had limited power to detect small effect sizes. In line with previous research, these studies

found that autistic individuals generally demonstrated poorer Theory of Mind abilities than typically developing individuals.

#### 2.4.2.4 Memory

No significant gender and diagnosis interaction was found on the Non-Word Repetition Task (Lai et al., 2012) or the Recent/Remote Memory task. The former task is associated with (non-verbal) auditory working memory, as opposed to verbal memory tasks, which may be influenced by individuals' language abilities. The Recent/Remote Memory task measures both short-term and long-term recall memory, and is scored based on the number of details provided in response to each memory cue (Goddard, Dritschel & Howlin, 2014). In this task, autistic individuals performed more poorly than typically developing individuals; otherwise there were no group differences for these tasks. However, a significant gender and diagnosis interaction was found for the Autobiographical Memory Cueing Task. Autistic males were found to produce fewer autobiographical memories than autistic females, whereas no such difference was found between typically developing males and females (Goddard, Dritschel & Howlin, 2014).

#### 2.4.2.5 Empathising, Systemising and Autistic traits

These traits represent a continuum of abilities reaching from the typical population, through those with an autism diagnosis. Systemising ability, measured by the Systemising Quotient (SQ), represents an interest and understanding of the mechanisms within a system. High levels of these abilities are associated with more autistic traits in sub-clinical populations as well as with a diagnosis of autism (Baron-Cohen et al, 2003). In contrast, higher levels of empathising abilities (measured by the Empathising Quotient [EQ]), such as understanding others' mental states and emotions, are generally found in individuals without an autism diagnosis and are associated with lower levels of autistic traits in the general population (Baron-Cohen & Wheelwright, 2004). Autistic traits describe behaviours and cognitive styles associated with autism that also exist in the general population, and are proposed to be more common in typically developing males

than females (Baron-Cohen, Wheelwright, Skinner, Martin & Clubley, 2001). Autistic traits are measured by the Autism Quotient (AQ).

An earlier study using smaller samples found no significant differences between autistic males and females on any of these traits, but found higher SQ traits in typically developing males, and higher EQ traits in typically developing females (Baron-Cohen et al., 2003; see Table 2.2). Interactions were not directly tested in this study, which was underpowered to detect small effect sizes. Baron-Cohen et al., (2001) found a significant interaction between group and gender for AQ scores, with typically developing males scoring higher than females, and no gender difference between autistic males and females. In contrast, a more recent study using a much larger sample and a larger proportion of autistic females found significant interactions between gender and diagnosis on all three traits (Baron-Cohen et al., 2014). Both autistic and typically developing groups displayed higher SQ and AQ scores for males, and higher EQ scores for females (see Table 2.2). However, gender differences in these studies were significantly smaller for autistic individuals, suggesting that autistic males and females may be more similar in their empathising, systemising and autistic traits than non-autistic males and females.

The study by Park et al. (2012) did not directly test interactions, but found no significant differences between autistic males and females on the SQ or EQ. Typically developing males had higher SQ scores than equivalent females, while no gender differences were found for the typically developing group on the EQ. Autistic males scored higher on the AQ than autistic females, but no significant differences were found between typically developing males and females on this measure (see Table 2.2). Similarly, Kirkovski et al. (2016) found that autistic females and males scored lower on the EQ and higher on the AQ than typically developing females and males. Gender differences within diagnosis groups were not reported in this study.

#### 2.4.2.6 Friendship



No significant interactions between gender and diagnosis were found using either the Friendship Questionnaire (Baron-Cohen & Wheelwright, 2003; Head, McGillivray, & Stokes, 2014) or the Friendships Survey (Dean et al., 2014). Using both measures, autistic individuals were found to perform more poorly than typically developing individuals (see Table 2.2). However, one study utilizing the Friendship Qualities Scale found that autistic males reported significantly lower closeness and helping in their best friendship than autistic females or typically developing children of either gender (Sedgewick et al., 2015).

#### 2.4.2.7 Internalising and Externalising

As a group, autistic individuals experienced more internalising and externalising behaviours than typically developing individuals. Although interactions were not tested, no gender differences were found for externalising or internalising behaviours, as measured by the Child Behaviour Checklist, in either autistic or typically developing groups (Park et al., 2012). However, this study was limited by a low proportion of autistic females, which means more subtle differences may have been missed. Similarly, internalising behaviours measured using the Behavioural Assessment System for Children revealed no gender differences in either autistic or typically developing groups (Solomon, Miller, Taylor, Hinshaw, & Carter, 2012). Although this study had a moderate sample size, gender and diagnosis interactions were not directly tested and the results of difference tests were not reported (see Table 2.2).

Through parent- and self-report, an interaction between sex, diagnosis and developmental stage was found for depressive symptoms, with autistic females demonstrating higher levels of depressive symptoms than either autistic males or typically developing females in early adolescence (Oswald et al., 2016). However, by late adolescence autistic males and females were found to have similar levels of depressive symptoms, with the change being explained by autistic males alone having a significant increase in depressive symptoms as they got older (see Table 2.2). The

same study also found a marginally significant interaction ( $p = .06$ ) between sex, diagnosis and developmental stage for anxiety, with autistic females and typically developing males reporting higher levels of anxiety than autistic males and typically developing females in early adolescence, but both autistic males and females reporting higher levels of anxiety than their typically developing peers by later adolescence.

Some significant gender and diagnosis interactions were found when looking at hyperactivity and inattention in particular. The study by May, Cornish, and Rinehart (2012) also looked at the effect of age on autism-related outcomes. They found that gender differences varied between autistic and typically developing groups, but that this variation depended on the age of the individuals (see Table 2.2). Younger autistic males (aged 7-9 years) were more impaired than younger autistic females, compared to typical males and females. By the time these children reached the age of 10-12 years, both autistic and typically developing groups showed similar gender differences, with males having higher levels of ADHD-related behaviours than females. As a group, autistic children at all ages demonstrated higher levels of inattention and hyperactivity than typically developing children.

#### 2.4.2.8 Play Behaviours

The study by Knickmeyer et al. (2008) found that autistic females demonstrate significantly less sex-typical pretend play relative to their typically developing peers than autistic males. No such gender differences were found for non-pretend play, where autistic males and females demonstrate similar play preferences to typically developing males and females, respectively. In contrast, Harrop and colleagues (2016) found that autistic males played with sex-typical cars and trucks less than their typically developing peers, whereas no differences in this play behaviour were found between autistic and typically developing females. While typical sex differences were found for other types of play, such as playing with dolls and houses, there were no differences between autistic females and typically developing females, or between autistic males and typically

developing males. One possible explanation for these different findings is that the study by Knickmeyer et al. (2008) utilized a sample with a greater range of ages, who were on average older, than the sample used by Harrop et al. (see Table 2.2).

## **2.5 Discussion**

### **2.5.1 Discussion of findings**

This study aimed to compare gender differences between autistic and typically developing individuals, to determine whether the patterns of difference vary between these groups. A difference in gender variation between groups would suggest separate autism phenotypes for males and females, with the potential implication of separate diagnostic criteria for each gender.

Meta-analyses found no variation in the profiles of gender differences for autistic and typically developing groups for the core autism symptoms of communication impairments and RRBIs, or for IQ. Gender differences in social impairments were found to vary depending on the age of the participants. Different patterns of variation in gender differences of social impairments were found for two studies including adolescents in their sample. One study found smaller gender differences in autistic than non-autistic groups, whereas the other study found larger gender differences for autistic participants. No variation in gender differences between groups was found for the other four samples, which included either children or adults only. Due to the small number of studies and contradictory findings in each of these studies, a conclusion of either greater or smaller gender differences in autistic social impairments cannot be drawn. However, these findings raise the importance of comparing gender differences across all ages, as there may be age-related variation in the similarities and/or differences between autistic and non-autistic groups which could not be fully assessed in this limited sample. In addition, the review of RRBIs focused on measures of the amount or severity of restricted interests, rather than the type of interests. Gender differences in the type or content of

autistic restricted interests were not assessed in this meta-analysis as this information was not available in the included studies.

These results suggest that typical gender differences in core symptoms and IQ also occur for autistic individuals, and, therefore, that autistic individuals are fundamentally similar to typically developing individuals in regard to their gender variation in core autism characteristics. This reflects the dimensional nature of autism, such that people above and below the diagnostic threshold for an autism diagnosis share traits which vary between sexes/genders.

In contrast, the review of gender differences in associated autism symptoms revealed some degree of variation between autistic and typical populations, suggesting that having autism may impact differently on males and females. Autistic males were found to have significantly more impaired performance on the trail-making task (one measure of executive function, focusing on task switching and cognitive flexibility), to produce fewer autobiographical memories, and have higher levels of hyperactivity (although only at a younger age) than autistic females, taking into account typical gender differences. In contrast, autistic females were found to be significantly more impaired on response inhibition, as measured by the stop task, and visual-spatial processing, as measured by the block design task. Play behaviours in autistic males and females were found to be different to those of typically developing males and females. However, the differences appear to depend on the age of the individual, with autistic females displaying more sex-typical behaviours than males as young children, but this pattern reversing between childhood and early adolescence. Age-related patterns were also found for internalising and externalising problems. At younger ages, autistic females generally reported higher levels of internalising problems while autistic males reported higher levels of externalising problems, a similar pattern to the typically developing groups. As the autistic children got older their levels of internalising and externalising problems became more similar. In particular, autistic males demonstrated increased levels of internalising problems as they developed, bringing them to a similar level as their female peers.

Although patterns of gender differences in autism, empathising, and systemising traits were the same in both groups, the differences were smaller for the autistic group, suggesting that autistic males and females are more similar in these respects. While some of these findings contradict those using other measures of the same characteristics, they raise the suggestion that male and female performance may vary depending on the task used, and encourage further testing of gender differences using a range of measures. The differences that have been found suggest that autistic males and females are not a homogenous group, but may have distinct patterns of ability and impairment which, so far, have not been thoroughly investigated.

In contrast, no significant interactions between gender and diagnosis were found for the majority of executive function tasks, attention to detail, theory of mind, most measures of friendship, and most memory tasks. These results suggest that any gender differences found in autistic groups here can be attributed to typical gender differences, rather than the specific differences found between autistic males and females. When evaluating autistic gender differences in these areas, typical gender performance should be taken into account to gain true measures of relative ability and impairment. However, it is also possible that gender variation between autistic and typically developing groups in these areas may have differed in size rather than direction, as was found for some of the cognitive traits associated with autism. Gender differences in autistic groups may therefore be broadly similar to those found in typically developing groups for these characteristics, but these differences may be larger within one group than the other.

Nevertheless, these findings suggest that autistic females express some additional characteristics in ways which are different to both autistic males, and non-autistic females. This conclusion provides support to the Female Autism Phenotype hypothesis, and suggests that further research into the precise nature of the female phenotype would be beneficial. Three components of the Female Autism Phenotype discussed in the introduction have been included in this review. Some evidence for patterns of friendship and internalising difficulties unique to autistic females was found. Although no difference

in gender variation between autistic and non-autistic males and females was found for restricted interests, these analyses focused on the amount and not content of interests, therefore conclusions regarding the 'focused interests' component of the Female Autism Phenotype could not be drawn. As there was no quantitative research into camouflaging at the time this review was performed, this component could not be examined. Conceptualisation and measurement of camouflaging, including potential gender differences in autistic and non-autistic individuals, is considered a priority for further testing of the Female Autism Phenotype hypothesis.

### 2.5.2 Limitations

A key limitation of this analysis is the small number of studies included, due to a dearth of research comparing autistic and typically developing groups. This limitation is extended by the end date of the literature review (September 2015), as more studies which would fit the inclusion criteria have been published since then. Meta-analysis based on a small number of studies is more susceptible to second-order sampling errors, because variation in standard deviations is more likely to be influenced by artefacts (Hunter & Schmidt, 2004). Several of the studies included in the qualitative review and meta-analyses were underpowered to detect small effect sizes, and so it is possible that significant variation in gender differences between groups was not picked up in our analysis. Consequently we echo the calls by many others (e.g., Lai et al., 2015) for future studies to include large enough numbers of males and females from both typical and autistic populations, in order to draw stronger and more consistent conclusions about gender differences.

Another consequence of the limited number of studies is that few potential confounding variables were identified or controlled for. Age was included as a moderator in the meta-analyses and in some of the reviewed studies, and was found to influence gender variation between groups in some areas. Previous studies have also identified IQ, ethnicity, comorbidities, and characteristics of ASD diagnosis, amongst other factors, as interacting with both gender and autism to produce differential outcomes over time

(Brugha et al., 2011; Croen, Grether, & Selvin, 2002; Farley et al., 2009; Holtmann, Bölte, & Poustka, 2007). Consistent measurement and reporting of these characteristics would enable better interpretation of these studies' heterogeneity, which is a significant limitation of the present meta-analyses. Our results should be interpreted with these limitations in mind, although we conclude that the finding of some significant variation in gender differences, despite these limitations, is robust and meaningful.

Although the most recent DSM-5 diagnostic criteria have combined social and communication impairments into one symptom, we analysed them separately. This is because some of the studies included in this analysis only measured either social or communication impairments, therefore scores for both could not be combined for all studies. In addition, hypo/hyper-reactivity to sensory stimulation is a criterion in DSM-5, but was not measured in many of the studies included here.

A final limitation is that this study was focused on behavioural and cognitive characteristics of autism only. While these characteristics are of the most relevance to diagnostic criteria (as physiological markers of autism have not been identified, and therefore diagnosis relies on behavioural information solely), there are many other characteristics of autism which also display gender variation. This chapter lacks the space to offer a full review of gender differences in all areas of research relating to autism. However, see recent reviews by Kirkovski et al. (2013), Lai et al. (2015), and Werling and Geschwind (2013) for more information on gender differences in neurodevelopmental, biological and genetic factors amongst other characteristics. A comparison of gender differences between autistic and typically developing groups in these characteristics would further broaden our understanding of the expression of autism in both males and females.

### 2.5.3 Conclusions and Next Steps

The results of this review and meta-analysis suggest that autism may present differently depending on an individual's gender. While core autism characteristics and IQ may

reflect typical gender patterns of ability, some associated autism characteristics produce different patterns for males and females, beyond typical gender variation. This supports the conclusions of several previous reports, that autistic females may present different cognitive and/or behavioural phenotypes to most autistic males. The next steps are therefore to further explore proposed components of this female autism phenotype, with a focus on one of the least-studied areas, that of camouflaging. This chapter concludes that gender differences in autistic individuals should also be compared to those in non-autistic individuals, if any conclusions regarding female-specific autistic behaviours are to be drawn. The conceptualisation and measurement of camouflaging behaviours are reported in Chapters 3 and 4, while gender differences in autistic and non-autistic adults' camouflaging strategies are explored in Chapter 5. Gender differences in some cognitive aspects of autism were also reported here, suggesting that innate cognitive ability may account for some variation in camouflaging experiences. To examine this in further detail, cognitive predictors of camouflaging are explored in both males and females in Chapter 7.



## **CHAPTER 3: CONCEPTUALISATION OF CAMOUFLAGING IN AUTISTIC ADULTS (STUDY 2)**

### **3.1 Abstract<sup>3</sup>**

In order to measure camouflaging and assess its role in the female autism phenotype, the concept of camouflaging must be comprehensively defined. This qualitative study examined camouflaging experiences in 92 autistic adults, with questions focusing on the nature, motivations, and consequences of camouflaging. Thematic analysis was used to identify key elements of camouflaging, which informed development of a three-stage model of the camouflaging process. First, motivations for camouflaging included fitting in and increasing connections with others. Second, camouflaging itself comprised a combination of masking and compensation techniques. Third, short- and long-term consequences of camouflaging included exhaustion, challenging stereotypes, and threats to self-perception. This conceptualisation of camouflaging provides the foundation for the development of conceptually valid measures of camouflaging, and allows the experiences and perspectives of autistic individuals to be integrated in future research into camouflaging.

### **3.2 Introduction**

#### **3.2.1 Camouflaging in autism**

While many neurotypical people, of all genders, manage the way others perceive them in social situations (Izuma, Matsumoto, Camerer & Adolphs, 2011), research suggests that autistic individuals have a reduced ability to do so (Cage, Pellicano, Shah & Bird,

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<sup>3</sup> Citation for the published, peer-reviewed article for this chapter:

Hull, L., Petrides, K. V., Allison, C., Smith, P., Baron-Cohen, S., Lai, M.-C., & Mandy, W. (2017). "Putting on My Best Normal": Social Camouflaging in Adults with Autism Spectrum Conditions. *Journal of Autism and Developmental Disorders*, 47(8). <https://doi.org/10.1007/s10803-017-3166-5>. See Appendix 11 for the article.

2013). However, the research in this area has focused on the manipulation of typical social behaviours, rather than how autistic individuals may want and be able to adapt their autism-related characteristics. Camouflaging is likely to exist on a spectrum (similar to autistic traits) in those who have an autism diagnosis and those who are subclinical, although self-reported evidence suggests possible categorical differences between autistic and non-autistic camouflaging. For instance, camouflaging by autistic individuals has been reported as extremely effortful and challenging to one's identity (Bargiela, Stewart & Mandy, 2016), unlike ordinary reputation management in typically developing individuals.

Camouflaging of autistic characteristics in certain settings may lead to the perception that individuals function well and do not experience any problems, even though those individuals still experience difficulties as a result of the interaction of their autism and the context. For example, it is suggested that autistic girls may mimic other socially successful individuals to give the impression that they too are socially successful, but when placed in unknown environments they are not prepared for, they struggle to socialise (Attwood, 2006). This may reflect both a stronger motivation to mimic, and itself be the result of a stronger motivation to 'systemize' social behaviour, than is seen in autistic males. Teachers or clinicians may therefore be unaware of the difficulties being faced by autistic girls and women, whereas family members may see their loved one in a range of situations and so realise the extent of their difficulties. Alternatively, women who receive an autism diagnosis later on in life may have spent years feeling different and attempting to minimise this difference, until their children receive a diagnosis and they recognise the symptoms within themselves (Holliday Willey, 2015).

Autistic individuals also display significant variation in their outcomes across the lifespan, especially concerning their social functioning. Some autistic adults form friendships and relationships, and have fulfilling careers that enable them to remain independent (Farley et al., 2009; Strunz et al., 2016). Others, however, struggle to maintain social relationships and may remain unemployed, despite having the motivations and

capabilities to work (Baldwin & Costley, 2015; Shattuck et al., 2012). While some of this variation is due to individual differences in cognitive abilities, language ability, and personal preference (Howlin, Mawhood, & Rutter, 2000; Shattuck et al., 2012; Van Bourgondien, Reichle, & Palmer, 1997), it is possible that an individual's ability to camouflage their autistic characteristics contributes to them achieving socially desirable outcomes. Individuals who are better able to camouflage their autistic characteristics might feel more able to make friends, improve their social support, and perform better in job interviews. Reported motivations for camouflaging in autistic adults comprise both 'conventional' reasons such as being taken seriously at work, and 'relational' reasons such as appearing attractive to others (Cage & Troxell-Whitman, 2019).

However, many autistic individuals also report extensive anxiety and depression, especially those with average-to-high levels of IQ and language abilities (Lugnegård, Hallerbäck, & Gillberg, 2011). Where camouflaging is unsuccessful, strenuous, or if the person feels forced to camouflage, it may be associated with high stress level, low mood and low self-esteem. Camouflaging, measured through an unvalidated scale, has been identified as one of the key predictors of suicide amongst autistic adults (Cassidy et al., 2018). In addition, the pressure to maintain successful camouflaging may lead to anxiety for autistic individuals. Camouflaging is not necessarily a beneficial behaviour, and should not be regularly expected or encouraged for autistic individuals, as this may risk increasing mental health problems. It is therefore important to study camouflaging in order to better understand the individual differences predicting long-term wellbeing and outcomes for individuals on the autism spectrum.

### 3.2.2 Unanswered questions about camouflaging

Some attempts to operationalise and therefore measure camouflaging have occurred, and these have been further discussed in Chapter 1 (Dean, Harwood & Kasari, 2017; Lai et al., 2017). Despite these encouraging first steps, key questions about camouflaging still need to be answered, such as how common camouflaging is within the autistic population, whether it varies across the lifetime, and whether individual

differences in camouflaging are related to long-term outcomes in functioning, achievement and quality of life. In addition, the majority of those diagnosed with autism identify as male, and a significant number of autistic individuals experience non-binary gender identities (Glidden, Bouman, & Jones, 2016; Kim et al., 2011). It is therefore important to examine camouflaging behaviours across all genders, as research so far has focused on female experiences.

Most importantly, studies of camouflaging in autism cannot progress until a conceptual model of camouflaging has been produced, so that subsequent research has strong theoretical grounding. Such a model is best developed from a qualitative analysis of the camouflaging experiences of autistic individuals. This will ensure that the construct of camouflaging reflects the real-life experiences of autistic individuals rather than the preconceptions of researchers or clinicians, and that our understanding of camouflaging is representative of a broad range of autistic individuals. Inductive (i.e. data-driven) research resulting in a comprehensive model of the camouflaging process will enable hypothesis generation and form the basis of measurement development to further explore camouflaging quantitatively.

### 3.2.3 The present study

The present qualitative study examined camouflaging in a large sample of adults of all self-identified genders who had been diagnosed with autism, using internet-based survey and thematic analysis. Emphasis was placed on the motivations for camouflaging, techniques used, the impact that camouflaging has for the individual, and their overall attitudes to camouflaging. The aim of the study was to derive a conceptual model of camouflaging to inform future research.

The following research questions were addressed:

- 1) What is camouflaging?
- 2) What are the techniques used and what do autistic people think camouflaging is?

- 3) Why do people camouflage their autism?
- 4) What are the consequences of camouflaging?

### **3.3 Methods**

#### **3.3.1 Participants**

Participants were 92 adults of 15 different nationalities (55% British). They were eligible to take part in the study if they were over the age of 16 years and had received a DSM-IV or DSM-5 diagnosis from a psychiatrist or clinical psychologist in a recognized specialist clinic of an ASD, including Autism / Autistic Disorder, Asperger Syndrome / Asperger's Disorder, Autism Spectrum Disorder, Atypical Autism, and Pervasive Development Disorder Not Otherwise Specified. Participants were recruited via the Cambridge Autism Research Database (CARD) and through adverts placed on social media. Whilst it was not possible for this study to independently verify the diagnostic status of participants, several measures were taken to check diagnostic status and establish the generalisability of findings from this sample. Participants were asked to report whether they had received an ASD diagnosis (and if so, at what age and from which type of healthcare professional) or whether they were self-diagnosed. Those who reported self-diagnosis, or who reported receiving an ASD diagnosis from someone other than a medical professional, clinical psychologist, or healthcare team, were excluded from current analysis ( $n = 3$ ). Demographic characteristics of participants are included in Table 3.1. Participants were asked to identify their gender as 'female', 'male' or 'other', and give more details if they wished.

Table 3.1. Demographic characteristics of participants and whether they reported camouflaging

	Female	Male	Other Gender
N	55	30	7
Age (mean years)	40.71 (SD = 14.14)	48.03 (SD = 16.62)	40.71 (SD = 14.29)
Age (range)	18-68	22-79	27-69
Age at diagnosis (mean years)	36.98 (SD = 14.21)	41.03 (SD = 18.08)	32.67 (SD = 9.25)
Camouflage? (Yes/No)	51/4	28/2	7/0
Nationality:			
British	30	17	4
North American	12	3	1
Western European	7	6	2
Other	6	4	0

*Note.* Three male participants reported their natal sex as female. All participants who identified their gender as 'Other' reported their natal sex as female.

### 3.3.2 Materials

A newly designed questionnaire of camouflaging was developed in consultation with other experts in autism, including clinicians, researchers, and autistic adults. The questionnaire included 23 closed and 20 open questions, and examined participants' motivations for camouflaging, the characteristics of their camouflaging experiences, the consequences of camouflaging (positive and negative), and their attitudes towards camouflaging (see Appendix 3). Closed questions were developed from predicted behaviours and observations raised during the development process, although

participants were able to give additional detail to their answers if they wished. Open questions were designed to elicit new insights from participants and identify experiences not anticipated by the researchers. Demographic information about the participants, including details of their autism diagnosis, was also obtained.

### 3.3.3 Procedure

Participants were emailed an online link to 'a study looking at experiences of coping behaviours in social situations' (which was hosted by Qualtrics) or followed a link posted on social media. They were reminded that they could withdraw at any point and were under no obligation to answer any question. Participants completed the survey at their leisure and were able to stop and start their responses as they chose, to minimise stress or discomfort from completing the survey.

Early in the questionnaire after demographic data had been ascertained, participants were asked the following question: "Have you ever had the experience of 'camouflaging' your autism? A reminder: in this survey we use the term 'camouflaging' to refer to 'coping skills, strategies, and techniques that function to "mask" features of Autism Spectrum Conditions (ASC) during social situations'." Those who responded 'no' were directed to the end of the questionnaire, where they could leave their thoughts on camouflaging if they wished. These responses were included in the final analysis. Those who responded 'yes' completed the full questionnaire. Four females (7% of total number of females) and two males (6% of total males) reported that they had never camouflaged their autism in social situations. All 7 participants who identified their gender as 'Other' reported camouflaging their autism. Responses were saved securely on the Qualtrics server in anonymised format.

Ethical approval for this study was obtained from the University of Cambridge Psychology Research Ethics Committee, reference number Pre.2015.036, as part of a collaborative agreement with University College London (reference 000025426). Informed consent was obtained from all individual participants included in the study.

### 3.3.4 Analysis

Analysis followed the six phases of thematic analysis recommended by Braun and Clarke (2006) with the aim of identifying patterns of information within the data which answered the research questions. This inductive (i.e., data driven) analytic approach was chosen because it does not rely on a rigid theoretical framework for interpretation, and so enables researchers to examine alternative perspectives and identify new information within developing areas of psychology (Willig, 2013). Guidelines for good qualitative research (Barker & Pistrang, 2005; Elliott, Fischer, & Rennie, 1999; Ritchie, Lewis, McNaughton Nicholls & Ormston, 2014) were followed to ensure that interpretations were credible and could be generalised beyond the existing sample. A consensus approach was taken with data extracts read thoroughly by the author and codes addressing the research questions identified. Initial codes were audited by an independent researcher to confirm that interpretations reflected the data accurately. These codes were then checked by two other researchers (Will Mandy [WM] and Meng-Chuan Lai [MCL]), and the finalised set of codes was grouped into themes and subthemes. All researchers discussed and refined themes until a consensus was reached. Member validation was used as a further credibility check: themes and subthemes were sent to six participants (five female, one male) who had expressed interest in the findings to ensure these accurately reflected their experiences.

### 3.4 Results

Seven themes, comprising 16 subthemes, were clustered into three stages of the camouflaging process, as detailed in Figure 3.1. Motivations (Assimilation and “To know and be known”) describe the reasons why respondents camouflaged their autism, including the aims they hoped to achieve as a result. What is Camouflaging? (Masking and Compensation) describes the concept of camouflaging itself, including the techniques used. Finally, the short- and long-term consequences of camouflaging are described through the themes “I fall to pieces”, “People have a stereotyped view”, and “I’m not my true self”. Names of themes and subthemes are taken directly from



quotations from respondents. The number of participants who referenced each theme at least once is displayed in Table 3.2.

Table 3.2. Number of participants who referenced each theme.

Theme	Number of Participants		
	Female (n = 55)	Male (n = 30)	Other Gender (n = 7)
Assimilation: "Hide in plain sight"	49	20	7
"To know and be known"	42	24	5
Compensation: "To exceed what nature has given"	45	22	7
Masking: "I'm hiding behind what I want people to see"	38	18	7
"I fall to pieces"	44	21	7
"People have a stereotyped view"	32	6	4
"I'm not my true self"	31	15	3

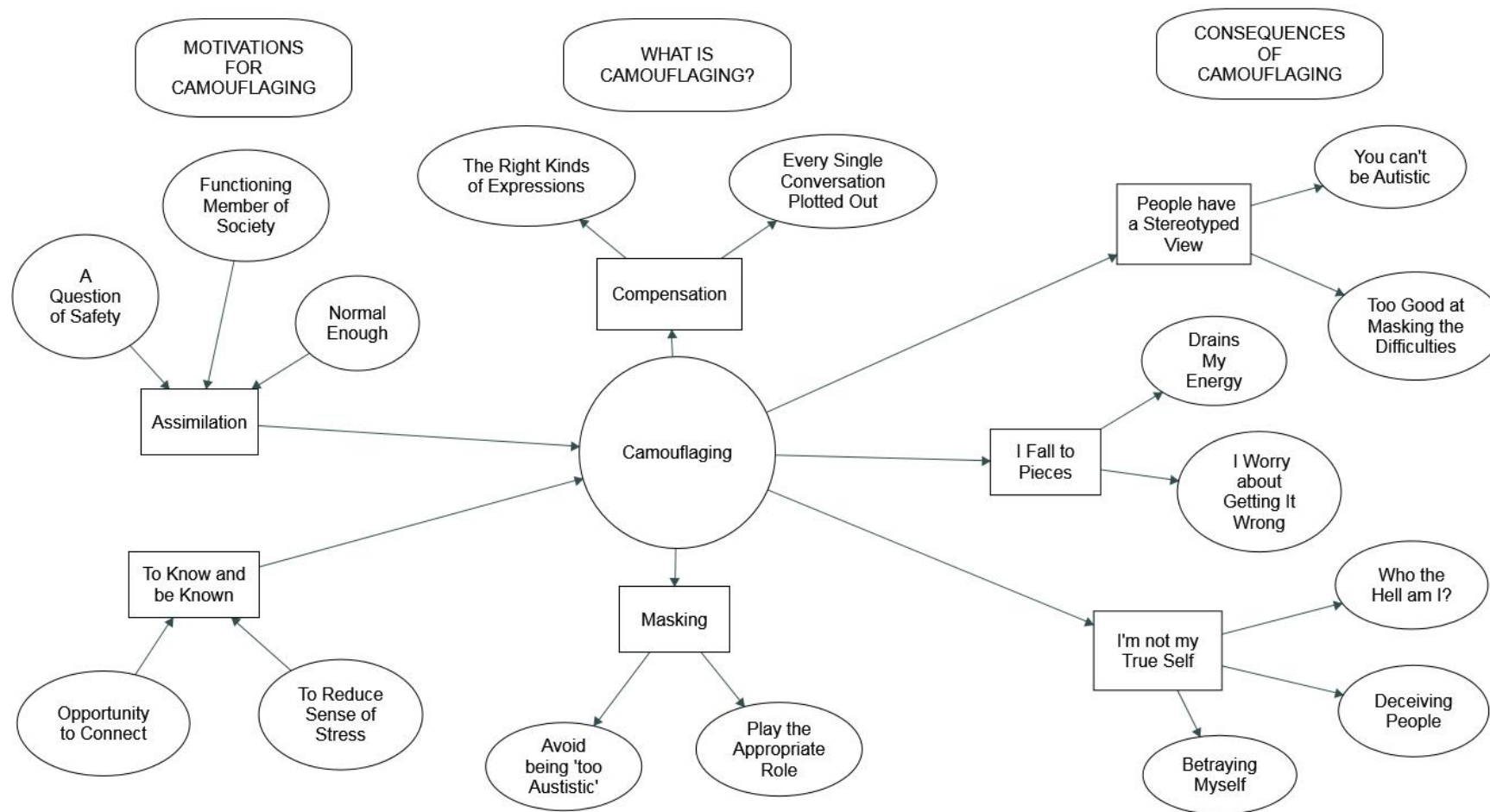


Figure 3.1. Thematic map of the three stages (Motivations, Camouflaging, and Consequences) of the camouflaging process. Themes are indicated by rectangles; subthemes by ovals.

### 3.4.1 Motivations for Camouflaging

#### 3.4.1.1 Assimilation: “Hide in plain sight”

Respondents described wanting to camouflage in order to ‘blend in with the normals’.

Most respondents reported a social expectation from the general population that autistic individuals need to change in order to be accepted by others. Respondents’ social and communication difficulties, and their unique behaviours and interests, meant that they stood out from the crowd during social situations. It was felt that the general population viewed this as unacceptable, and so respondents felt a pressure to change their behaviours in order to seem ‘normal enough’.

*[I camouflage] to reduce the threat of feeling uncomfortable through being unable to measure up to social expectations. (Male, 62)*

*I don't want to draw attention to myself by appearing to be different. (Female, 30)*

However, a few respondents suggested that their motivations to camouflage were similar to those of the general population; camouflaging was simply seen as the way in which everyone tries to fit in or hide less desirable aspects of their personality:

*Most neurotypicals are camouflaging nearly all the time they are in public. (Male, 79)*

A more pragmatic aspect of this motivation was the desire to obtain jobs and qualifications, which respondents felt were less accessible when they were more visibly autistic. Many respondents described how they would not have achieved as much had they been more open about their autistic characteristics. Camouflaging during these situations was thought to improve employment opportunities, and so enable them to become a ‘functioning member of society’.

*I'm pretty sure no-one would ever hire me if I didn't camouflage in job interviews. (Other Gender, 27)*

*Camouflaging helps to survive in school and college and it is important for keeping jobs. (Female, 27)*

The desire for assimilation was also prompted by concerns for their own safety and wellbeing. Many described being ostracised, verbally or emotionally attacked, and some even reported physical assaults when they had not camouflaged their autism:

*When I was younger and more obviously odd and strange I was thought of as stupid and also badly physically and mentally bullied. I also lost employment. I want to avoid the bullying mostly. I have even been spat at in the street. (Female, 49)*

Most attributed this to their perceived differences compared to others, and used camouflaging techniques to minimise these differences and hence reduce the threat. This was particularly the case when describing their experiences in childhood and adolescence; respondents often reported that relations with others improved as they got older and were better able to camouflage their autism.

*If I had known how to camouflage earlier, perhaps I wouldn't have been such an outcast as a child. (Other Gender, 41)*

#### 3.4.1.2 "I want to know and be known"

The other key motivation for camouflaging was to increase connections and relationships with others. Due to their inherent social difficulties, many respondents reported struggling to make friends and form romantic attachments, despite this being a strong desire. Camouflaging was seen as one way to overcome the initial obstacles to connection and allow for future relationships to develop.

Many respondents wanted to be accepted by others and be able to socialise, but recognised that they lacked the skills needed to make small talk, interact comfortably with strangers, and relax in social situations. This limited their ability to get to know people better. As will be discussed further in the theme 'Compensation', camouflaging offers solutions to some of these issues. The payoffs in terms of easier social interaction were a strong motivation for many respondents to camouflage their autism with others. However, several respondents felt camouflaging was only necessary for the initial stages of a friendship or relationship; once a connection was established, the respondent felt more comfortable showing their 'true' autistic characteristics.

*I know it is necessary when I am first getting to know someone. After I have known them for a while and they know I have Asperger's and they are accepting of my quirks, then I can let my guard down more. Connections have to be made initially on neurotypical terms. Then, hopefully, on my terms as well. (Female, 46)*

For some, the risk of failure and associated embarrassment created severe anxiety during social interactions; by camouflaging and using structured techniques, respondents could reduce some of this uncertainty and so were more confident in their ability to socialise. Respondents felt that camouflaging would lead to success in a variety of social situations, when compared to their default behaviours or responses.

*It enables me to be with other people in a way that is relatively comfortable for me and for them. I avoid looking like a socially clumsy idiot. It avoids the embarrassment and awkwardness of getting things wrong. (Female, 56)*

### 3.4.2 What is Camouflaging?

#### 3.4.2.1 Masking: "I'm hiding behind what I want people to see"

Masking encompasses the aspects of camouflaging that focus on hiding one's autistic characteristics and developing different personas or characters to use during social

situations. Both of these emphasise a distinction between the respondent's 'true' or 'automatic' behaviours, and what they present to the rest of the world.

Camouflaging was partly performed through suppressing, hiding, or otherwise controlling behaviours associated with autism that were seen as inappropriate in the situation. The extent to which this happened could vary depending on who the person was with; camouflaging tended to occur less often with close friends and family members, although some respondents described camouflaging at all times.

Respondents described attempting to minimise their self-soothing or 'stimming' behaviours, and their responses to sensory overstimulation, in order to make their condition less obvious to others. These techniques included using objects as 'props' to meet sensory needs in a subtle way, and giving themselves regular excuses to leave overstimulating environments and calm down.

*I prevent myself from doing any particularly visible or otherwise noticeable stims: I still find myself doing things like shaking my leg repeatedly without noticing, but don't make any noises people would think are weird, don't full-body shake (like with the leg but...all of me), or do any finger movements or tapping etc. that would annoy people. (Female, 20)*

Masking enabled respondents to present a different identity to the outside world, one that covered up those parts of themselves they were not happy with. The combination of controlled behaviour and appropriate conversation produced through camouflaging was often described as essential during social interactions, even though this meant concealing one's actual personality.

*I don't think I'll ever completely stop wearing the mask. It's a defence mechanism really. It is easier to have people you're friendly with, than taking the mask off and revealing the real broken you. (Female, 18)*

In some cases, this went as far as portraying an entirely different character, and several respondents likened it to acting or performing a role, complete with costumes. The character or aspects of the role could change across different situations:

*I camouflage by putting on a character... I treat my clothes rather like costumes, and certain items of clothing help me to uphold certain personality characteristics of which character I am on that occasion. I have a repertoire of roles for: cafe work, bar work, uni, various groups of friends, etc. They are all me at the core, but they are edited versions of me, designed to not stand out for the 'wrong' reasons. (Female, 22)*

One way to easily identify the appropriate role to play was to mimic the behaviours of others during a social interaction. Behaviours could be copied directly from the person in front of them, or could be identified and learned from observing others interacting, and even from watching television and films. Some respondents went as far as to copy clothing style, mannerisms, and even interests from others.

*I try to copy socially successful people by trying to imitate their speech and body language and trying to understand their interests. (Male, 71)*

#### 3.4.2.2 Compensation: "To exceed what nature has given"

The other aspects of camouflaging centre around developing explicit strategies to meet the social and communication gaps resulting from an individual's autism, which we call compensation. These camouflaging techniques include specific non-verbal communication strategies and guidelines for successful conversations with others. Respondents often described these techniques as 'rules' or expectations from others that had to be met, even if they themselves felt these rules were not necessary.

Explicit, compensatory strategies were reported by many respondents as a vital way to improve non-verbal communication with others. These strategies aimed to help the

individual perform behaviours used in typical social encounters, which they would not necessarily perform naturally. Respondents described how these camouflaging techniques required intensive monitoring of the way they presented themselves, in order to ensure they were being performed as correctly as possible.

Forcing and maintaining appropriate eye contact, or attempting to look as close to another's eyes as possible, was a common compensatory technique reported. Respondents also made an effort to display facial expressions of emotion or interest, even if they didn't feel this inside. Different expressions were identified as important for different situations, and so many respondents described keeping a mental list of how to behave depending where they were.

*I look in people's eyes when I first meet them/or in formal/professional situations even though I wouldn't naturally, because I know you're supposed to. (Female, 26)*

*I try to look people in the eye and make faces that fit the situation. (Other Gender, 27)*

Many respondents noted that their preferred levels of emotional expression and body language did not match those of others around them, and so over-emphasised these behaviours in order to communicate better. This included non-verbal and verbal signs of interest in the interaction, which were also used to encourage others to continue speaking and so take the pressure off the autistic individual to respond appropriately.

*My autistic lack of non-verbal signals are read as hostility, arrogance or indifference by people, so I have to act the good will that I genuinely feel. (Female, 45)*

*I'm not good at knowing when it's my turn and I also tend to just blurt out things*



*or keep talking when I should have stopped, so I prep myself always in social situations to have a reminder or tag or internal buzzer about not speaking too much and trying to do more listening, nodding, agreeing. (Female, 49)*

In addition to these non-verbal techniques, respondents reported developing rules or guidelines to compensate for some of the social difficulties they experienced during conversations. These were more generalised and so could be prepared ahead of time and applied to different situations. These camouflaging strategies were used to help the autistic individual get through 'small talk' or more in-depth conversations with minimal stress, and to make the chat more enjoyable for their social partners.

One rule was to ask questions of the other people. Explanations for this varied between respondents, but included minimising the amount of time they had to speak, giving them more time to prepare things to say, and ensuring the autistic individual did not take over the conversation by talking about themselves or their own interests.

*I've recently tried to institute a rule about asking more "you" questions - how did that make you feel, what did you do next, what do you think about a given thing - instead of "me" or "I" statements. (Male, 29)*

*My issue is talking too much or saying the wrong things. I tend to think of one or two questions to ask the person and most people are so happy just to talk about themselves that it stops them shining a spotlight on me. I find asking questions is the best deflection and camouflage ever. (Female, 49)*

Respondents were often aware that talking only about themselves and their interests was not socially acceptable and so developed strict rules to control their self-focused talk. For some, camouflaging also involved not divulging personal details about themselves, whether to protect themselves from being taken advantage of, or to maintain privacy.

*I say as little about myself as possible as the more I say, the more likely it is that I say something inappropriate OR give away too much information about myself which can then be used against me. (Other Gender, 31)*

*I remain silent when I might otherwise have spoken, knowing that I can't always tell whether or not my comments would be welcome. I make generic comments rather than offering specific ones that might reveal my more unusual traits. (Male, 29)*

Respondents also described spending time before an interaction to prepare topics of conversation, including questions to ask, anecdotes to relate, and potential responses to others. These made them feel more in control of the interaction, and reassured them that they would have structured 'scripts' to follow rather than having to spontaneously 'chat':

*I usually also think up stories and how whole conversations might go before I have them so I have responses practiced as well as potential things to say if the conversation 'dries up'. (Female, 20)*

However, it is important to emphasise that not all respondents developed such structured rules for conversation; some simply had the goal of speaking as little as possible in order to get out of the interaction quickly.

*In these social situations, I do not talk about anything of interest to me, I avoid talking much and just pretend to be interested in what people are saying. (Female, 42)*

### 3.4.2 Consequences of Camouflaging

#### 3.4.2.1 "I fall to pieces"

By far the most consistent consequence of camouflaging described by respondents was exhaustion. Camouflaging was frequently described as being mentally, physically, and emotionally draining; requiring intensive concentration, self-control, and management of discomfort. The longer a camouflaging session continued, the harder it became to maintain the intended level of camouflaging. Many respondents reported needing time to recover after camouflaging, where they could be alone and release all of the behaviours they had been suppressing.

*It's exhausting! I feel the need to seek solitude so I can 'be myself' and not have to think about how I am perceived by others. (Other Gender, 30)*

In addition to this exhaustion, after a camouflaging session was over some respondents would experience extreme anxiety and stress. Respondents felt significant pressure, whether from themselves or others, to camouflage successfully, but many were uncertain of how effective their camouflaging strategies were. Twenty one respondents (10 male, 11 female) reported being unsuccessful in their camouflaging attempts or reported that they had not achieved the outcomes they intended.

*I try to ask them about the things they like, question after question, to keep conversation going but sometimes it doesn't work and they leave me. (Female, 27)*

Camouflaging therefore often involved a constant monitoring of the situation, as if training oneself in self-monitoring, self-awareness, and monitoring others' reactions, both during and after the interaction occurred, which induced stress and even greater anxiety.

*My head will be racing as if I'm interpreting another language. I will be incredibly anxious. It's like studying for an exam, constantly on edge trying to predict what*

*others will say and do. (Female, 49)*

*I hate it. I go over and over and over what they said and what I said. Did I understand them correctly, did I respond appropriately, did I make a gaffe? Have I offended anyone? (Female, 45)*

In contrast, a minority of respondents reported feeling satisfied and relieved after camouflaging, particularly if they felt as though it went well. For these individuals, camouflaging was rewarding because it enabled them to achieve what they wanted with minimal effort, whether that was getting through a necessary social situation, or being able to make a connection with someone. Interestingly, 60% of those who reported feeling positive or relieved after camouflaging were male (n = 9, compared to six females), in contrast to the majority female total sample.

*Small sense of achievement and relief that it is over. (Male, 69)*

*I am glad that the camouflaging enables me to survive within myself and accomplish any necessary tasks. (Male, 62)*

#### 3.4.2.2 “People have a stereotyped view”

Many respondents felt that, because their camouflaging changed the way they presented themselves to others, they did not meet the stereotype of ‘an autistic person’ when they camouflaged. In many ways this was construed as positive, since it allowed them to get on in life, succeed in jobs and relationships, and achieve many of the aims they wanted. Some also reported that this enabled them to challenge commonly held views of autism, especially for women. By demonstrating good social skills and educating others about their conditions, respondents hoped to change the public perception of autism and make others more understanding.

*People don't always realise that I have AS, more likely to be socially accepted, more likely to get a job. (Male, 28)*

*I feel that I'm showing the people I work with that autistic people can have people skills and be good role models (Female, 28)*

Some female respondents (n = 7) suggested that others were surprised that they were autistic, since they differed so much from the public perception of an autistic man with high maths skills, poor eye contact, and uncommon interests.

*So many people have a stereotyped view of what ASC looks like. They think people with AS are all geeky, and have little empathy and little insight. They think people with ASC bore on and on about their pet subject and make tactless remarks. They don't realise that women with ASC tend to internalise things much more and do have empathy and insight, and are very careful not to make hurtful remarks. (Female, 56)*

However, there were also negative consequences to not appearing autistic to others. The most striking was that for some respondents their camouflaging, even if it was involuntary, resulted in a delay or questioning of their autism diagnosis. Respondents reported that parents, teachers, and even clinical professionals refused to believe they could have autism, especially if they were female:

*The amount of girls that aren't diagnosed because they are more likely to camouflage than boys is really bad. I went for so long without being diagnosed because they didn't know that I could pretend to be normal! (Female, 20)*

In addition to this, respondents described failing to receive adequate support or allowances for their autistic difficulties, because these difficulties were often hidden behind the mask of camouflaging. Others would therefore give them more responsibilities

or expectations than the respondent was comfortable with, because of a perceived level of capability that did not always actually exist.

*After beginning graduate school, a lot of issues arose because I was camouflaging to the point that my support needs weren't being met. So, in that instance, it was detrimental to camouflage. (Female, 24)*

*I am an SEN teacher and my boss doesn't know when I am camouflaging. Currently highly stressed because she keeps giving me more work and not realising the stress it is causing. (Female, 44)*

For some respondents, this reflected the idea that camouflaging was not a conscious choice; they described wanting to control when and how they camouflage to a greater degree, in order to access support when they needed it:

*People need to learn how to drop the camouflage when in situations such as medical assessments or dealing with support professionals otherwise they may be under assessed for support as they appear to be coping. (Female, 28)*

For others, however, camouflaging was seen as a deliberate technique to avoid detection. Thus, increasing general awareness of camouflaging strategies by the public, and particularly by employers, was seen as 'outing' an autistic individual without their consent. These respondents feared that by giving others the tools to identify their camouflaging, the negative consequences they were trying to avoid would still happen.

*If they [employers] can identify camouflaging, then they will "find us out" and reject us. (Female, 68)*

### 3.4.2.3 “I’m not my true self”

The final consequence reported by respondents was that camouflaging affected their perception of themselves, in particular how they represented themselves to the outside world and their sense of authenticity. For many respondents, by camouflaging their ‘true’ or natural behaviours they were lying about who they were. This was often regretted by the respondents, who wanted to be happy as they were, but felt that the pressures of the typical social world meant this was not possible.

*I don't care about being different, I like my differences (apart from things feeling really stressful and no confidence) but I don't want to deal with peoples' negative and sometimes evil reactions. I feel like the weight of a black cloud is hanging on me having to be this fake version of me. (Female, 48)*

In an extension of this, for some respondents their camouflaging behaviours contradicted the important role they attributed to autism in shaping their identity. Despite feeling proud of their autism diagnosis, and the community they were a part of, they still deliberately camouflaged the behaviours associated with this diagnosis. These individuals felt that by hiding their autistic characteristics, they were betraying the autism community as a whole.

*It's mentally exhausting constantly having to be something else, literally never being able to be myself, and kind of sad too I guess? I even stop myself doing certain tics and things automatically when I'm by myself and that kinda sucks, that I'm not even me on my own. I guess I'm letting down the side a bit by hiding my autism; I am very vocal about stigmas and stereotypes with mental illness, and do talk about my anxiety openly, so I don't know why autism is different. (Female, 20)*

Some respondents felt that the relationships they formed through camouflaging were based on deception, and therefore the relationships themselves were false. This

reinforced experiences of loneliness and isolation, as they felt no one truly knew them or understood them. Some also felt bad for deceiving their friends and even loved ones.

*I feel sad because I feel like I haven't really related to the other people. It becomes very isolating because even when I'm with other people I feel like I've just been playing a part. (Female, 30)*

*I was married for 15 years and was camouflaging in high gear during that time... My husband would occasionally say to me that he wondered if I was really who I was. I think he would get glimpses of the real me. I didn't even know who the real me was...The marriage ended in divorce. (Female, 64)*

The situations in which respondents camouflaged were so extensive for some, they felt that they were losing sense of who they truly were. Respondents often felt they were playing so many different roles, it was hard to keep track of their authentic sense of identity. This increased the anxiety and stress associated with camouflaging, as individuals lost a sense of grounding and security in who they were.

*Sometimes, when I have had to do a lot of camouflaging in a high stress environment, I feel as though I've lost track of who I really am, and that my actual self is floating somewhere above me like a balloon. (Female, 22)*

## **3.5 Discussion**

### **3.5.1 Discussion of findings**

This study identified key themes underlying the motivations, techniques, and consequences associated with social camouflaging amongst autistic adults. The vast majority of participants (male, female, and of other genders) reported camouflaging to some degree, although there was significant variation in individual experiences of



camouflaging. The results were combined into a model of the camouflaging process, which we hope will contribute to the generation of testable hypotheses and identification of avenues for future research.

The themes revealed two key motivations for camouflaging; assimilation and connection. This suggests that camouflaging behaviours come from multiple sources. They may be internally driven by the individual to accomplish specific goals such as friendships, but they may also be produced as a response to external demands placed on how a person should behave in society. The differential influence of each of these motivations varies between individuals, but our findings suggest that people are strongly motivated by wanting to avoid discrimination and negative responses from others. This conclusion is supported by a recent study demonstrating that non-autistic individuals judge autistic people more negatively, and are less willing to interact with them, even after only brief exposure to the autistic individual (Sasson et al., 2017). Several participants in the present study suggested that improved education and acceptance of autism amongst the general public would improve their social experiences significantly, and would allow them to both fit in and increase their connections without the need to camouflage.

Respondents described a wide variety of techniques used as part of their camouflaging behaviours, and further research is needed to determine the extent to which specific techniques can be generalised to all people who camouflage. Masking comprises strategies used to hide autistic traits or present a non-autistic persona to others, while compensation involves using strategies to overcome social difficulties associated with autism. Both types of techniques may involve either conscious, learned processes which can be developed over time (for example preparing scripts for use during conversations), or innate processes which the individual may not even be aware of (such as mimicking others' tone of voice or accent).

There was extensive variation in the consequences of camouflaging reported, but one of the most striking findings was that the vast majority of participants reported some

unpleasant and unwanted consequences of camouflaging. These included the exhaustion experienced during and after camouflaging, which has been identified in previous research (Tierney et al., 2016). Our findings suggest that, if autistic people want to continue camouflaging in the ways reported in our study, those supporting them should be aware of the associated strains. Time alone to recover was identified as an important tool to help participants continue camouflaging, and could be utilised by employers and schools to make these environments more accessible for autistic individuals.

In addition, a profound consequence of camouflaging was a change in self-perceptions, as detailed by the theme 'I'm not my true self'. Camouflaging appears to challenge many participants' views towards themselves, and produce negative emotions and attitudes, such as being a 'fake' or losing their identity. It may be that the rigidity of thinking and scrupulous honesty that are present in many autistic individuals leads them to view any change in self-presentation as false (Chevallier, Molesworth, & Happé, 2012). Regular camouflaging would consequently increase the individual's perception of themselves as a 'liar' or inauthentic person, and could lead to long-term negative impacts on self-esteem. This could account for the finding that some participants viewed camouflaging as lying, in contrast to those who viewed it as a performance.

We can only speculate whether differences in participants' attitudes towards camouflaging, including the motivations and techniques used, may lead to differences in the consequences of camouflaging. Interestingly, positive consequences were reported more frequently by males than females or those of other genders. This could suggest that camouflaging is more likely to be a satisfying process for autistic males given present gendered social-cultural contexts; alternatively, it may reflect gender differences in the actual camouflaging techniques used, which produce different consequences. However, some participants reported that their camouflaging strategies were not always performed successfully; a relatively large proportion of these participants were male, in contrast to the gender ratio of the overall sample. There may be a discrepancy between desire to camouflage and ability to do so, and this too should be investigated in different genders

and across the entire autism spectrum. The potential gender difference corresponds well with a recent study showing on-average lower level of camouflaging and stronger association between camouflaging and depressive symptoms (i.e. the more camouflaging, the higher level of depression) in autistic men, compared to autistic women (Lai et al., 2017). It may be that autistic females who camouflage tend to do so more successfully than males. These hypotheses must be empirically tested using well-validated measures of camouflaging.

This study was not designed to test the role of camouflaging in the gender disparity in autism diagnosis. We found that relatively equal numbers of males and females, and all individuals of other genders, reported camouflaging, and no consistent patterns of differences in camouflaging behaviours between males and females were identified. However, some female and other-gender participants argued that camouflaging was a specific reason for their own or others' late diagnosis, suggesting that society places higher demands on social ability and assimilation for people perceived as female. Indeed, a recent study in elementary school children shows that the gendered, female social landscape supports autistic girls for camouflaging (e.g., staying in close proximity to peers) and therefore if clinicians and teachers rely on a male landscape to detect autistic characteristics (e.g., social isolation on the playground), females will tend to be left unidentified (Dean et al., 2017). Further examination of the impact of camouflaging behaviours in all genders is essential to understand the difficulties in accessing support by those who do not show a 'typical' autistic presentation.

One explanation for the similarities in camouflaging between males and females found here is that our sample was self-selecting, in response to a call for participants for 'a study looking at experiences of coping behaviours in social situations'. Although previous experience of camouflaging was not required to take part in the study, potential participants might have interpreted the advertisement in this way. It is therefore possible that our sample comprised only those people who had experienced camouflaging, which might include a substantial number of autistic females, but a smaller proportion of autistic

males. The majority of those who did not take part, because they had never or only rarely experienced camouflaging, may have more likely been male. Further investigation of camouflaging behaviours across the entire autistic population would shed more light on this.

An alternative explanation is that camouflaging is equally common in autistic males and females. Previous research has either theorised that camouflaging is more common in females (Lai et al., 2011; Wing, 1981b), has only included female samples (Bargiela et al., 2016; Tierney et al., 2016), or has observed on-average more evident camouflaging in females than males (Dean et al., 2017; Lai et al., 2017). If camouflaging does indeed lead to not receiving an autism diagnosis, there may, in fact, be a significant number of both males and females missing out on the support they might need. However, this also leads to a point that was raised by some of the participants who reported not camouflaging – the concept that if people are camouflaging so successfully that they are not diagnosed, they may not need a diagnosis or related support. While this may seem plausible to those who view camouflaging as a successful, low-impact strategy, the significant difficulties and uncertainty reported by our participants tell us that people who camouflage still need to be able to access appropriate support.

This issue reflects a concern voiced by some participants, viz. that increasing the awareness of camouflaging in the general public might actually lead to worse outcomes for some autistic individuals. Those participants who used camouflaging to hide their autism, especially at work, often viewed their camouflaging as a defensive strategy protecting them from discrimination. They worried that if other people were able to identify camouflaging, the autistic individual might lose this protection and be treated unfairly. An important next step in this stage of research is to examine the extent to which camouflaging in autism can be identified by others, and whether it impacts on the impressions formed of the autistic person. Many participants felt their camouflaging was at times unsuccessful, or reported occasions where another person had commented on their techniques. This concern suggests that research and public education regarding

camouflaging needs to be performed in consultation with a range of people from the autism community to ensure that increasing information helps rather than harms. More crucially, this concern voiced by some participants once again emphasises that the outcome of autistic individuals does not solely rely on personal characteristics – it can more fundamentally rely on how the social contexts treat them. A better person-environment fit is the key, and this involves ‘treating the environment’ to reduce stigmatization attached to autism and barriers to social life (Lai & Baron-Cohen, 2015).

### 3.5.2 Strengths and Limitations

One strength of this study was the high proportion of females and those of non-binary gender, many of whom were diagnosed later in life. This is an under-represented population, and it is important to include their voices and insights, which may be different to those of the majority male, younger samples included in previous research. However, because of this our sample was not fully representative of the entire autism community. Intellectual ability was not measured, although it can be assumed that participants should have had close to or average cognitive abilities in order to be able to complete the online, text-based survey. The cognitive and self-reflecting abilities required to complete the survey may also mean that our sample were better able to perform successful camouflaging behaviours than others on the autism spectrum.

As a result, our findings cannot be said to represent the views of those autistic individuals who also have intellectual disability, or who cannot express themselves in written English. Developing more accessible measures of camouflaging, such as self-report questionnaires that can be orally or visually administered, or measures to identify camouflaging behaviours, would improve our ability to understand camouflaging across the whole ASC community. Larger and more varied samples of individuals from across the autism spectrum should be included to further refine our understanding of camouflaging in the future.

The inductive nature of this study has identified novel avenues for research, such as focusing on the impact of camouflaging on identity, which may not have otherwise been considered. In addition, although camouflaging has previously been described as mainly a female expression of autism, we found that many males and individuals of other genders also reported camouflaging. A recent study operationalising camouflaging using existing autism-related measures also shows wide variability of the level of camouflaging in autistic men and women, indicating that camouflaging is not a female-specific phenomenon (Lai et al., 2017). In the present study, no statistically tested gender differences in camouflaging behaviours or outcomes were presented due to the qualitative nature of the data, and no analysis of the subjective or objective success of camouflaging attempts was made. However, our findings have produced the first known conceptual model of camouflaging, with key themes and components as identified by individuals who camouflage.

### 3.5.3 Conclusions and Next Steps

This chapter suggests that camouflaging of autism-related characteristics in social situations may be a common behaviour amongst autistic adults. Camouflaging is motivated by the desire to fit in with others and to make connections. The behaviours themselves can be grouped into masking and compensation strategies. In the short term, camouflaging results in extreme exhaustion and anxiety; although the aims of camouflaging are often achieved, in the long-term there are also severe negative consequences affecting individuals' mental health, self-perception, and access to support. Our findings demonstrate that camouflaging is an important aspect in the lives of many autistic individuals.

The conceptualisation of camouflaging presented in this chapter can be used to inform the development of ecologically valid measures of camouflaging behaviours. The development and validation of such a measure is reported in Chapter 4, and gender differences in camouflaging scores are reported in Chapter 5. Our findings also suggest a need to evaluate the subjective success of camouflaging attempts, as these may relate

to variable outcomes for the individual in terms of mental health and access to autism support and diagnosis. Chapter 6 addresses this by examining the relationship between self-reported camouflaging and the impression formed by others.

## CHAPTER 4: DEVELOPMENT AND VALIDATION OF THE CAMOUFLAGING AUTISTIC TRAITS QUESTIONNAIRE (CAT-Q; STUDY 3)

### 4.1 Abstract<sup>4</sup>

There currently exist no validated questionnaire-based measures of camouflaging, limiting the ways in which camouflaging can be studied and identified clinically. The self-report Camouflaging Autistic Traits Questionnaire (CAT-Q) was developed from autistic adults' experiences of camouflaging, and was administered online to 354 autistic and 478 non-autistic adults. Exploratory factor analysis suggested three factors, comprising of 25 items in total. Good model fit was demonstrated through confirmatory factor analysis, with measurement invariance analyses demonstrating equivalent factor structures across gender and diagnostic group. Internal consistency ( $\alpha = 0.94$ ) and preliminary test-retest reliability ( $r = 0.77$ ) were acceptable. Convergent validity was demonstrated through comparison with measures of autistic traits, wellbeing, anxiety, and depression. The CAT-Q can be used as a reliable and valid self-report measure of camouflaging in autistic and non-autistic males and females, allowing for further research exploring gender differences in camouflaging.

### 4.2 Introduction

The qualitative research described in the previous chapter has offered new insights into under-investigated social behaviours in autism, and has raised important questions to address: Who, among the many different autistic people, camouflages their autism? Do autistic girls and women camouflage more than boys and men, and does this partly

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account for gender disparities in the rate and timing of diagnosis (Begeer et al., 2013; Loomes, Hull, & Mandy, 2017)? What is the relationship between camouflaging and mental health outcomes? Quantitative investigation of these questions has to date been hindered by the challenges of accurately measuring camouflaging.

#### 4.2.1 Self-Report Measures of Social Camouflaging

In recent years there have been some attempts to quantify social camouflaging by autistic people. The resultant instruments reflect different ways of defining and operationalising camouflaging, leading to some overlap but also some discrepancies in how camouflaging behaviours are measured. As described in Chapter 1, many researchers have followed a 'discrepancy' approach computing the difference between proxy measures of internal autistic status and performance on behavioural or cognitive measures of external autistic presentation (Lai et al., 2017; Livingston & Happé, 2017). Others have followed an 'observational/relational' approach, where camouflaging behaviours are directly observed and reported on, although this is limited by the need for behaviours to be recognisable by the observer (Dean, Harwood & Kasari, 2017).

Another observational/reflective approach to the operationalisation of camouflaging addresses this issue by asking autistic people themselves about their camouflaging behaviours. Here, camouflaging is conceptualised based on the reported experiences of individuals who have (and have not) camouflaged their autism, and the behaviours and intentions described by these individuals are used to develop a list of camouflaging strategies to measure. Autistic individuals can then report directly on their own camouflaging behaviours, identifying strategies and intentions that might not be visible to an observer without in-depth discussion with the autistic person themselves.

This self-report method, based on an observational/reflective approach, has several strengths. First, identifying camouflaging behaviours based on strategies reported by autistic individuals reduces the potential for introducing bias via researchers' and clinicians' perceptions of autistic behaviours and abilities. Autistic adults have previously

reported being told by clinicians that their ability to camouflage (for example, by making or appearing to make eye contact) meant they could not be autistic, despite meeting autism diagnostic criteria in other ways (see Chapter 3). Clinicians and researchers may only observe autistic individuals in one structured and limited situation and so may not identify certain behaviours as camouflaging strategies, whereas autistic individuals and those who know them well have a unique insight into their own behaviours across a variety of situations. Second, self-report measures of camouflaging allow for operationalisation of the attempt to camouflage – the intention put into camouflaging autistic characteristics, and the techniques used, which may not result in any observable external change for someone who does not know the person well.

Both the discrepancy and observational/reflective approaches described previously offer ways to define and therefore measure camouflaging in autism. All the methods used or suggested have their own strengths and weaknesses, thus combining multiple methods in a triangulation approach allows for greater accuracy in measuring and identifying a complex phenomenon such as camouflaging (Thurmond, 2001). Participant report is needed to identify intention to camouflage, behavioural observation to identify how successful that camouflaging is, and measures of cognitive traits and autistic characteristics to identify how much the person is camouflaging their underlying ‘autistic-ness’ and how they do or do not achieve this. Methods for measuring behavioural camouflaging, and cognitive and autistic-like traits, already exist or have been proposed (Dean, Harwood & Kasari, 2017; Lai et al., 2017, Livingstone & Happé, 2017); however until now, no self-report measures of camouflaging behaviours have been developed.

#### 4.2.2 Camouflaging Across the Dimensions

Autism is a dimensional characteristic; traits are distributed across the entire population, but with a cut-off point at the extreme end requiring clinical identification and support (Constantino, 2011; Ruzich et al., 2015; Skuse, Mandy, & Scourfield, 2005). All individuals in the general population have some level of autistic traits, and those with an above average number may also camouflage these to varying extent. Camouflaging is

similar to impression management, where behaviours which occur in front of others are manipulated in order to make a better impression (Leary & Kowalski, 1990). Autistic individuals engage in impression management to a lesser degree than non-autistic individuals (Cage, Pellicano, Shah, & Bird, 2013). The combination of underlying autistic characteristics and extent of (successful) camouflaging produces an external 'autistic' presentation, with corresponding variation in general functioning (Livingston & Happé, 2017). Thus, it is important to develop measures of camouflaging that are appropriate for both autistic and non-autistic populations.

#### 4.2.3 The present study

A psychometrically sound self-report measure of camouflaging behaviours is needed to improve current understanding of the nature, causes and consequences of social camouflaging. Furthermore, existing methods of measuring camouflaging behaviours have not been validated in both autistic and non-autistic populations.

The aim of this study is therefore to develop, psychometrically evaluate, and validate a self-report measure of social camouflaging behaviours (henceforth referred to as the Camouflaging Autistic Traits Questionnaire; CAT-Q), appropriate for both autistic and non-autistic populations.

##### 4.2.3.1 Development

Preliminary items for the CAT-Q were developed from qualitative responses identified as part of the study described in Chapter 3, and were added to and refined by all the authors and several external experts, including autistic adults and clinicians.

##### 4.2.3.2 Psychometric evaluation

Exploratory and confirmatory factor analyses were used to identify, refine, and test the underlying factor structure of the CAT-Q in two separate samples. Multi-group measurement invariance analyses were used to compare the underlying factor structure in the male and female autistic and non-autistic samples.

Internal consistency of the measure was estimated using Cronbach's alpha, and test-retest reliability was established by re-sending the CAT-Q to a subsample of 30 autistic participants approximately three months after they first completed the survey.

Convergent validity of the new measure was determined by comparing camouflaging scores with scores on theoretically related constructs (Cronbach & Meehl, 1955). Individuals with more autistic-like traits are likely to camouflage those traits to a greater extent, although this has not been tested empirically before. Camouflaging has also been associated with increased social anxiety and general anxiety, and decreased wellbeing, in qualitative reports (see Chapter 3), as well as with increased depression in quantitative research (Cage, Di Monaco & Newell, 2017; Lai et al., 2017). Accordingly, convergent validity was explored by testing the correlation between camouflaging and autistic-like traits, social anxiety, general anxiety, wellbeing, and depression.

## **4.3 Methods**

### **4.3.1 Participants**

Validation of the CAT-Q was conducted in autistic and non-autistic samples which were recruited separately. Autistic participants were recruited via social media, through the Cambridge Autism Research Database (CARD), and through word-of-mouth. Non-autistic participants were recruited via social media and through word-of-mouth. Participants who self-reported as autistic were asked to detail the type of diagnosis, (e.g. Autism, Asperger's Syndrome, Autism Spectrum Disorder), the age they were diagnosed, and the type of healthcare professional who diagnosed them. Those who reported being self-diagnosed were automatically excluded from the study and did not complete any further questions.

Of those autistic participants who reported the age they were diagnosed, 12% were diagnosed in childhood (0-17 years) and 72% were diagnosed in adulthood (18 years and over). Of those diagnosed in childhood, 38% were diagnosed by a psychiatrist, 25% by a clinical psychologist, 8% by other specialists including neurologists and specialist

nurses, 5% by a multi-disciplinary team, 2% by a Speech & Language Therapist, 2% by their school, and 2% by a paediatrician. Of those diagnosed in adulthood, 55% were diagnosed by a clinical psychologist, 35% by a psychiatrist, 3% by a multi-disciplinary team, 3% by other specialists, 0.7% by a Speech and Language Therapist, 0.7% by a GP, and 0.3% by an occupational therapist.

In the autistic sample, 14% were aged 16-25, 23% were aged 26-35, 20% were aged 36-45, 13% were aged 56-65, 3% were aged 66-75, and 0.3% were aged 75 or over. In the non-autistic sample, 59% were aged 16-25, 16% were aged 26-35, 8% were aged 36-45, 9% were aged 46-55, 6% were aged 56-65, 1% were aged 66-75, and 0.2% were aged 75 or over (proportions may not add up to 1 due to rounding).

#### 4.3.2 Measures

##### Camouflaging Autistic Traits Questionnaire (CAT-Q)

The measure's operationalisation of social camouflaging is based on the analysis and theoretical model described in Chapter 3. Items for the CAT-Q were identified through multiple routes. The study described in Chapter 3 also asked participants to describe specific behaviours they used while camouflaging. These responses were refined to produce a list of behaviours reflecting the two core components of camouflaging identified previously: compensation (i.e. finding ways around the social and communication difficulties associated with autism), and masking (i.e. hiding aspects of one's autistic presentation, or presenting a non-autistic persona to others). Additional camouflaging behaviours were suggested by autism experts, including researchers, clinicians, and autistic adults who were consulted directly.

Once the behaviours were identified, items that described them, including reverse-coded items describing the opposite of these behaviours, were developed. Items were removed or added to ensure there was a roughly even number tapping into 'compensation' and 'masking'. A total of 48 items were produced for inclusion in the study. Participants responded using a seven-point Likert scale, from 'Strongly Disagree' to 'Strongly Agree'

with each statement. A total of 832 participants (354 adults with autism and 478 adults without autism) completed the CAT-Q.

Broad Autism Phenotype Questionnaire (BAPQ; Hurley, Losh, Parlier, Reznick, & Piven, 2007)

A 36-item self-report measure of traits associated with the broader autism phenotype (BAP). BAP characteristics are associated with greater genetic liability for autism, and are found across the population and at especially high levels in relatives of those with an autism diagnosis. Scores for the total questionnaire and three sub-factors (Aloofness, Pragmatic Language, and Rigidity) are averaged across the 36 items in the total questionnaire and 12 in each factor, to produce values in a range of 0-6. A total of 744 participants (299 autistic and 445 non-autistic) completed the BAPQ. The BAPQ has good sensitivity (Sasson, Lam, Childress et al., 2013) and specificity (Hurley et al., 2007). Internal consistency of the BAPQ in the current study (total sample) was high ( $\alpha = 0.96$ ). Although the BAPQ was initially developed as a measure of autistic-like traits in relatives of those with autism, it has also been used to measure autistic-like traits in autistic and non-autistic groups (Ingersoll et al., 2011; Nishiyama et al., 2014; although see Piven & Sasson, 2014 for an evaluation of this approach). In this case we included the BAPQ as a measure of autism-related characteristics, rather than as a screening tool for autism. Mean BAPQ scores were compared for autistic and non-autistic samples and were found to be significantly different ( $t[743] = 21.23, p < .001, d = 1.56$ ), with means of 4.31 (SD = 0.69) for autistic participants and 3.18 (SD = 0.73) for non-autistic participants. This suggests that, although the BAPQ was designed for relatives of those with autism, there were no ceiling effects in the autistic sample.

Social Anxiety Scale (LSAS; Liebowitz, 1987)

A 24-item self-report questionnaire measuring social anxiety in the general population. The scale requires participants to imagine being in different social situations (such as talking to a sales assistant in a shop) and asks how much fear they would experience

and how much they would avoid the situation. The LSAS has demonstrated good test-retest reliability and discriminant validity (Baker, Heinrichs, Kim, & Hofmann, 2002). A total of 708 participants (284 adults with autism and 424 adults without autism) completed the LSAS. In the total sample of this study, internal consistency was high ( $\alpha = 0.97$ ).

Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS; Tennant et al., 2007)

A 14-item self-report questionnaire measuring general wellbeing in the last two weeks. The WEMWBS has demonstrated acceptable validity and reliability (Trousselard et al., 2016). A total of 713 participants (289 adults with autism and 424 adults without autism) completed the WEMWBS. Internal consistency in the total sample was high ( $\alpha = 0.92$ ).

Patient Health Questionnaire (PHQ-9; Kroenke, Spitzer, & Williams, 2001)

A 9-item self-report questionnaire of depressive symptoms in the last two weeks, with a clinical cut-off point of 10 for moderate depression. The PHQ-9 has demonstrated good sensitivity and specificity for depressive symptoms (Kroenke, Spitzer & Williams, 2001). The PHQ-9 was only administered to autistic individuals. A total of 290 autistic participants completed the PHQ-9. Internal consistency in the autistic sample was acceptable ( $\alpha = 0.89$ ).

Generalised Anxiety Disorder (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006)

A 7-item self-report measure of generalised anxiety symptoms in the last two weeks. The GAD-7 has a clinical cut-off point of 10 points and demonstrates good sensitivity and specificity (Spitzer, Kroenke, Williams & Löwe, 2006). The GAD-7 was only administered to autistic individuals. A total of 289 autistic participants completed the GAD-7. Internal consistency in the autistic sample was high ( $\alpha = 0.92$ ).

#### 4.3.3 Procedure

Participants followed a link to the online survey, hosted by Qualtrics, where they read the information sheet and, after contacting the researchers to answer any questions,

completed a consent form. They then completed demographic questions and questionnaires.

Participants who had given contact details to researchers were contacted again three months later to ask them to re-take the questionnaire for the purpose of estimating test-retest reliability. At that time, adverts were also placed on social media inviting autistic participants who had previously completed the survey to complete it again.

Ethical approval for this study was obtained from UCL Research Ethics Committee (ID numbers 7475/002 and CEHP/EP/2016/0004). Informed consent was obtained from all individual participants included in this study.

#### 4.3.4 Analyses

All analyses were performed in R (R Core Team, 2013).

The total sample was split in two, with the first half utilised for exploratory factor analysis to identify an initial factor structure from which a 25-item final scale was produced ('exploratory sample';  $N = 402$ ), and the remainder utilised for confirmatory factor analysis ('confirmatory sample';  $N = 430$ ). These two samples had comparable levels of autistic-like traits; however the confirmatory sample was significantly younger on average (partial  $\eta^2 = 0.13$ ), and contained proportionally more males (Cramer's  $V = 0.12$ ), than the exploratory sample.

##### 4.3.4.1 Exploratory Factor Analysis

Principle components analyses using oblique rotation were performed on the total exploratory sample ( $N = 402$ ), and separately in the autistic ( $N = 200$ ) and non-autistic ( $N = 202$ ) subsamples. Retention of items was based on combined evaluation of the scree plot, following Cattell (1966); eigenvalues over 1.0; and parallel analysis techniques to model factor structure (Hayton, Allen, & Scarpello, 2004). Items with loadings below 0.40, or with cross-loadings of greater than 0.40 were excluded.



#### 4.3.4.2 Confirmatory Factor Analysis

Diagonally Weighted Least Square Means (WLSM) estimators were used to take into account the ordinal nature of the Likert-based responses (DiStefano & Morgan, 2014; Wang & Cunningham, 2005). The key indices used to assess goodness-of-fit were Comparative Fit Index (CFI), where values of 0.95 or greater indicate good fit; Root Mean Square Error of Approximation (RMSEA), where values of 0.06 or lower indicate acceptable fit; and Standardised Root Mean Square Residual (SRMR), where values of 0.08 or lower indicate acceptable fit (Hu & Bentler, 1999).

#### 4.3.4.3 Multi-group Measurement Invariance

The total sample was recombined and multi-group measurement invariance analysis used to determine whether the same latent variables were measured across four groups: male autistic, female autistic, male non-autistic, and female non-autistic. Participants who identified as a non-binary gender or did not report their gender were excluded from this analysis (n = 92).

Tests of measurement invariance involve the comparison of multiple, nested models (Sass, 2011) measuring: 1. Configural Invariance (whether factor structure is equal across groups); 2. Metric Invariance (whether item loading on each factor is equal across groups); 3. Scalar Invariance (item intercepts are equal across groups); and 4. Residual Invariance (item residuals are equal across groups). Each model is compared to the previous in a forward approach to first establish invariance across groups, and then test whether non-invariance has been identified at each additional level.  $\Delta$ CFI of less than 0.01 is generally used as the most reliable marker of invariance, as  $X^2$  values can be influenced by sample size (Cheung & Rensvold, 2002). Diagonally Weighted Least Square Means (WLSM) estimators were again used, and robust statistics are reported for all results. Satorra-Bentler scaled corrections for multiple comparisons were used.

#### 4.3.4.4 Reliability and validity

Internal consistency, test-retest reliability, and convergent validity of the final scale were assessed in a subset of the total sample who had also provided complete responses to at least one of the other measures in the study (N = 706; Autistic N = 306, Non-Autistic N = 400). Internal consistency was measured using Cronbach's alpha, and test-retest reliability using Pearson's r and intra-class coefficients (ICCs). Two-way consistency ICC was used to evaluate absolute consistency between the first and second completion of the questionnaire, (McGraw & Wong, 1996), with unity reflecting complete consistency on all items between time one and time two. Values of 0.50 to 0.75 indicate moderate reliability, while values of 0.75 and above indicate good reliability (Koo & Li, 2016).

Convergent validity was assessed using correlations between total CAT-Q and factor scores, and measures of autistic-like traits, social anxiety, well-being, generalised anxiety, and depression.

### **4.4 Results**

The characteristics of the total sample and all subsamples are described in Table 4.1.

Table 4.1. Sample characteristics

	Total Sample	Autistic Subsample	Non-Autistic Subsample	Exploratory Subsample	Confirmatory Subsample
N	832	354	478	402	430
(male/ female/ other gender/not stated)	(300/434/ 46/52)	(108/179/ 17/50)	(192/255/ 29/2)	(139/246/ 17/0)	(161/188/ 29/52)
Mean age in years (SD)	36.01 (14.84)	41.93 (13.55)	30.24 (13.72)	37.02 (15.02)	35.15 (14.21)
Age range in years	16-82	18-75	16-82	16-82	16-72
Mean age at autism diagnosis (range)	-	34.2 (2-66)	-	34.47 <sup>a</sup> (2-66)	33.82 <sup>a</sup> (3-66)
Native language = English	617	244	373	346	271
Employed full- or part-time	308	135	173	182	126
Student	257	36	221	123	134
Retired or homemaker	62	43	19	39	23
Unemployed or unable to work	86	64	22	42	44

NB: some participants chose not to answer some demographic questions; <sup>a</sup> value for autistic participants only

#### 4.4.1 Exploratory Analyses

Parallel analysis suggested four factors, but examination of the scree plot and eigenvalues suggested that three common factors best fit the data across the autistic, non-autistic, and combined samples, in addition to being a simpler structure. The three factors were labelled Compensation (strategies used to actively compensate for difficulties in social situations), Masking (strategies used to hide autistic characteristics or portray a non-autistic persona), and Assimilation (strategies that reflect trying to fit in with others in social situations). These three factors accounted for 38% of variance in the autistic subsample, 41% of variance in the non-autistic subsample, and 45% of variance in the combined exploratory sample. Factor correlations were medium-to-high (Cohen, 1988) between all factors in all samples (Table 4.2).

Table 4.2: Factor correlations in autistic (A), non-autistic (NA) and combined (C) samples.

	Compensation			Masking			Assimilation		
	A	NA	C	A	NA	C	A	NA	C
Compensation	-	-	-	0.5	0.47	0.39	0.44	0.58	0.66
Masking	0.5	0.47	0.39	-	-	-	0.21	0.39	0.33
Assimilation	0.44	0.58	0.66	0.21	0.39	0.33	-	-	-

Items that loaded onto one of the three factors at or above the critical value of 0.40 in both the autistic and non-autistic subsamples, and in the combined sample, were identified. These were reduced to twenty-five items based on the highest factor loadings, which resulted in a total of 8 items each in the Masking and Assimilation factors, and 9 items in the Compensation factor. Table 4.3 presents the mean scores and internal consistencies of the factors and total scale across the autistic, non-autistic, and combined samples.

Table 4.3: CAT-Q Total and factor scores in the autistic (A; N = 200) and non-autistic NA; (N = 202) subsamples and the combined exploratory sample (C; N = 402). Raw scores have been rescaled to reflect the 7-point Likert scale.

Scale	No. of Items	Mean (SD)			Internal Consistency (Cronbach's $\alpha$ )		
		A	NA	C	A	NA	C
Total	25	4.79 (0.99)	3.48 (1.04)	4.13 (1.21)	0.91	0.93	0.94
Compensation	9	4.42 (1.31)	2.89 (1.27)	3.65 (1.50)	0.88	0.90	0.92
Masking	8	4.55 (1.35)	4.29 (1.10)	4.42 (1.24)	0.87	0.84	0.86
Assimilation	8	5.29 (1.15)	3.32 (1.27)	4.30 (1.56)	0.86	0.89	0.93

Autistic participants scored significantly higher than non-autistic participants on the Total CAT-Q ( $t [401] = 12.98, p < .001$ ; partial  $\eta^2 = 0.30$ ) and Compensation ( $t [401] = 11.90, p < .001$ ; partial  $\eta^2 = 0.26$ ), Masking ( $t [401] = 2.19, p = .03$ ; partial  $\eta^2 = 0.01$ ), and Assimilation factors ( $t [401] = 16.35, p < .001$ ; partial  $\eta^2 = 0.40$ ). Factor loadings on all three factors in the final, 25-item Camouflaging Autistic Traits Questionnaire (CAT-Q) are detailed in Table 4.4.

Table 4.4: Factor loadings of the 25-item CAT-Q in autistic, non-autistic and combined (Com) exploratory subsamples. Loadings of 0.30 and greater are in bold.

Item	Factors								
	Compensation			Masking			Assimilation		
	Autistic	Non-Autistic	Com	Autistic	Non-Autistic	Com	Autistic	Non-Autistic	Com
When I am interacting with someone, I deliberately copy their body language or facial expressions.	<b>0.48</b>	<b>0.60</b>	<b>0.58</b>	0.17	0.08	0.15	0.00	0.06	0.01
I learn how people use their bodies and faces to interact by watching television or films, or by reading fiction.	<b>0.73</b>	<b>0.76</b>	<b>0.77</b>	0.09	0.04	0.06	-0.10	0.01	0.02
I have tried to improve my understanding of social skills by watching other people.	<b>0.73</b>	<b>0.73</b>	<b>0.73</b>	0.04	0.03	0.04	-0.13	0.02	0.04
I will repeat phrases that I have heard others say in the exact same way that I first heard them.	<b>0.59</b>	<b>0.53</b>	<b>0.57</b>	-0.28	0.15	-0.06	0.22	0.09	0.18

	Compensation			Masking			Assimilation		
	Autistic	Non-Autistic	Com	Autistic	Non-Autistic	Com	Autistic	Non-Autistic	Com
I practice my facial expressions and body language to make sure they look natural.	<b>0.51</b>	<b>0.61</b>	<b>0.61</b>	<b>0.32</b>	0.15	0.25	-0.03	0.04	-0.03
I have spent time learning social skills from television shows and films, and try to use these in my interactions.	<b>0.83</b>	<b>0.72</b>	<b>0.79</b>	-0.01	-0.01	0.01	-0.03	0.15	0.09
In my own social interactions, I use behaviours that I have learned from watching other people interacting.	<b>0.76</b>	<b>0.74</b>	<b>0.73</b>	0.02	0.13	0.10	-0.03	0.01	0.04
I have researched the rules of social interactions (for example, by studying psychology or reading books on human behaviour) to improve my own social skills.	<b>0.61</b>	<b>0.41</b>	<b>0.56</b>	0.06	0.02	0.03	-0.01	0.15	0.14
I have developed a script to follow in social situations (for example, a list of questions or topics of conversation).	<b>0.53</b>	<b>0.46</b>	<b>0.48</b>	0.02	0.17	0.09	0.28	0.16	0.28

	Compensation			Masking			Assimilation		
	Autistic	Non-Autistic	Com	Autistic	Non-Autistic	Com	Autistic	Non-Autistic	Com
I monitor my body language or facial expressions so that I appear relaxed.	0.03	<b>0.32</b>	0.17	<b>0.85</b>	<b>0.60</b>	<b>0.75</b>	0.02	0.04	-0.02
I adjust my body language or facial expressions so that I appear relaxed.	0.08	<b>0.31</b>	0.22	<b>0.79</b>	<b>0.56</b>	<b>0.69</b>	-0.06	0.06	-0.04
I monitor my body language or facial expressions so that I appear interested by the person I am interacting with.	0.11	0.22	0.16	<b>0.71</b>	<b>0.52</b>	<b>0.66</b>	0.12	0.09	0.03
I adjust my body language or facial expressions so that I appear interested by the person I am interacting with.	0.06	0.23	0.15	<b>0.74</b>	<b>0.57</b>	<b>0.69</b>	0.07	0.08	0.02
I don't feel the need to make eye contact with other people if I don't want to (Reversed).	-0.02	-0.23	-0.18	<b>0.59</b>	<b>0.30</b>	<b>0.52</b>	-0.01	0.14	0.01
In social interactions, I do not pay attention to what my face or body are doing (Reversed).	0.00	0.07	0.03	<b>0.82</b>	<b>0.47</b>	<b>0.69</b>	-0.11	0.12	-0.01



	Compensation			Masking			Assimilation		
	Autistic	Non-Autistic	Com	Autistic	Non-Autistic	Com	Autistic	Non-Autistic	Com
I always think about the impression I make on other people.	-0.01	0.02	-0.08	<b>0.39</b>	<b>0.61</b>	<b>0.52</b>	0.17	0.05	0.13
I am always aware of the impression I make on other people.	-0.10	-0.06	-0.16	<b>0.44</b>	<b>0.63</b>	<b>0.54</b>	0.01	-0.16	-0.08
I rarely feel the need to put on an act in order to get through a social situation (Reversed).	0.00	-0.13	-0.08	0.24	0.19	0.21	<b>0.56</b>	<b>0.69</b>	<b>0.71</b>
When talking to other people, I feel like the conversation flows naturally (Reversed).	-0.08	-0.11	-0.03	-0.14	-0.02	-0.13	<b>0.70</b>	<b>0.75</b>	<b>0.85</b>
When in social situations, I try to find ways to avoid interacting with others.	0.01	0.28	0.14	-0.21	-0.21	-0.18	<b>0.66</b>	<b>0.66</b>	<b>0.75</b>
In social situations, I feel like I'm "performing" rather than being myself.	0.04	0.04	0.06	0.12	0.27	0.11	<b>0.70</b>	<b>0.57</b>	<b>0.75</b>
I have to force myself to interact with people when I am in social situations.	0.06	0.17	0.10	-0.05	-0.11	-0.05	<b>0.72</b>	<b>0.72</b>	<b>0.77</b>

	Compensation			Masking			Assimilation		
	Autistic	Non-Autistic	Com	Autistic	Non-Autistic	Com	Autistic	Non-Autistic	Com
In social situations, I feel like I am pretending to be "normal".	0.00	0.21	0.09	0.19	0.18	0.13	<b>0.65</b>	<b>0.58</b>	<b>0.74</b>
I need the support of other people in order to socialise.	0.08	<b>0.31</b>	0.16	-0.11	-0.04	-0.07	<b>0.60</b>	<b>0.52</b>	<b>0.66</b>
I feel free to be myself when I am with other people (Reversed).	-0.07	-0.15	-0.10	0.19	0.10	0.09	<b>0.63</b>	<b>0.69</b>	<b>0.81</b>

#### 4.4.2 Confirmatory Factor Analyses

Confirmatory factor analysis was performed on the confirmatory sample (N = 419; Autistic N = 150, Non-Autistic N = 269); the results for the autistic, non-autistic, and combined group analyses for the total scale are reported in Table 4.5.

Table 4.5. Fit of 25-item total CAT-Q scale across autistic (N = 154), non-autistic (N = 276) and combined confirmatory subsamples (Com; N = 430). Robust statistics are reported.

Sample	X <sup>2</sup>	Df	CFI	RMSEA (90% CI)	SRMR
Autistic	596.947***	272	0.970	0.056 (0.050 – 0.063)	0.075
Non- Autistic	619.099***	272	0.983	0.046 (0.041 - 0.051)	0.058
Com	969.527***	272	0.980	0.052 ( 0.048 - 0.055)	0.057

\*\*\* p < .0001. X<sup>2</sup> = Chi squared; Df = degrees of freedom; CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; 90% CI = 90% confidence intervals; SRMR = Standardised Root Mean Square Residual

Overall, the model fit was acceptable; CFI values were above 0.95, and RMSEA and SRMR values were well within the recommended range in all three samples. The model tested is detailed in Figure 4.1.

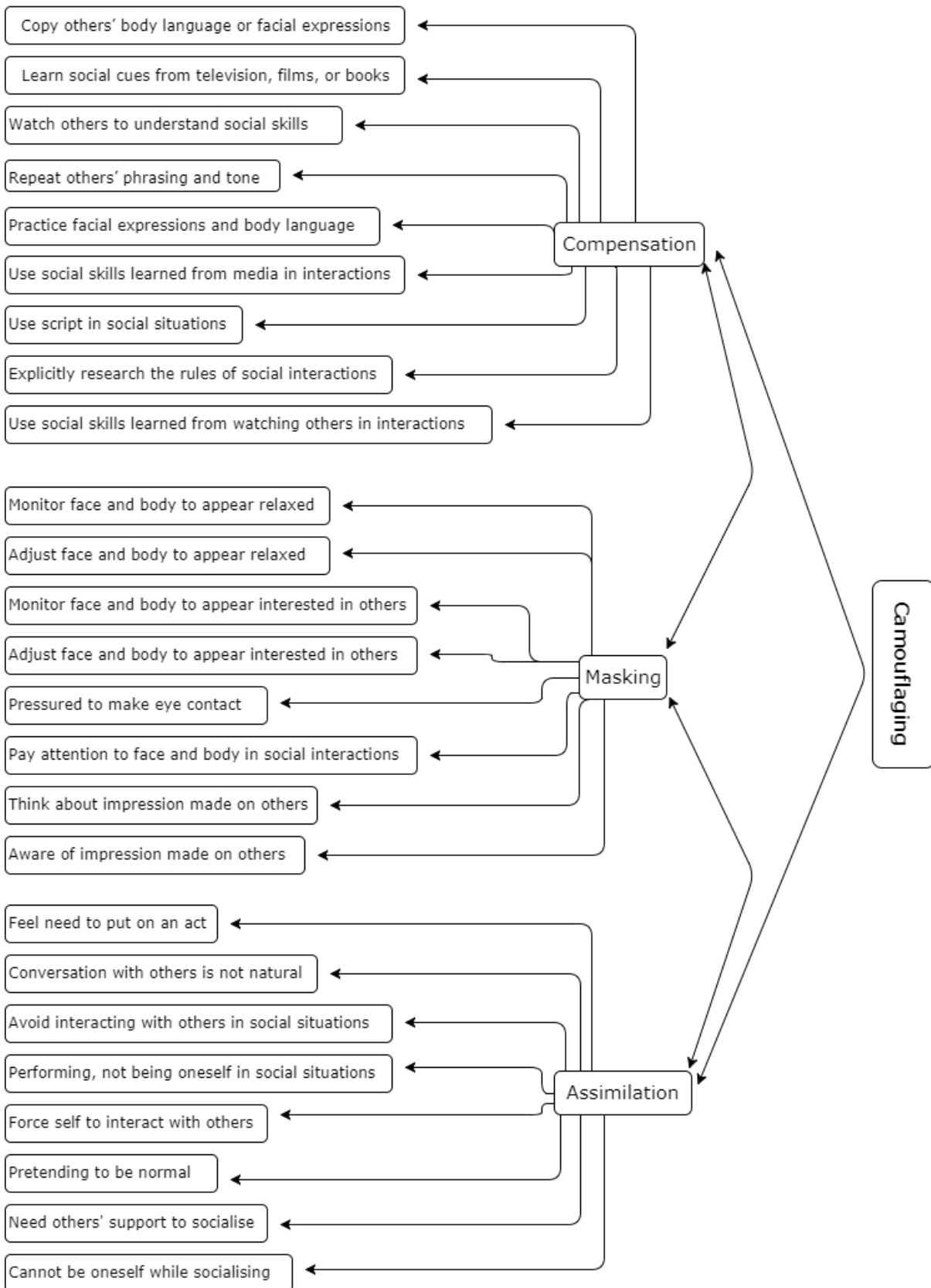


Figure 4.1. Social Camouflaging model

#### 4.4.3 Invariance Analyses

Measurement invariance (as demonstrated by  $\Delta\text{CFI} < 0.01$ ) was found for item loadings (Model 2), intercepts (Model 3), and residuals (Model 4) between the autistic and non-autistic male and female samples (as shown in Table 4.6). Model fit was close to or within acceptable limits for all models. It was concluded that the CAT-Q demonstrates strict invariance between autistic and non-autistic males and females.

Table 4.6: Multi-group measurement invariance model comparison (Autistic Male N = 107; Autistic Female N = 181; Non-Autistic Male N = 192; Non-Autistic Female N = 256). Robust statistics are reported.

Model	$X^2$	$\Delta X^2$	Df	CFI	$\Delta\text{CFI}$
1. Configural Invariance	2434.22	-	1088	0.947	-
2. Metric Invariance	2353.93	80.29	1154	0.953	0.006
3. Scalar Invariance	2628.31	272.38	1220	0.945	0.008
4. Residual Invariance	2856.15	227.84	1295	0.939	0.006

$X^2$  = Chi Squared;  $\Delta X^2$  = Chi Square difference; Df = degrees of freedom; CFI = Comparative Fit Index;  $\Delta\text{CFI}$  = CFI difference

#### 4.4.4 Reliability and Validity

Reliability and validity of the finalised, 25-item scale were assessed in a subset of the total sample that had also provided complete responses to at least one of the other measures included (N = 706; Autistic N = 306, Non-Autistic N = 400).

#### 4.4.4.1 Reliability

High internal consistency was found for the total scale (Cronbach's  $\alpha = 0.94$ ), and the Compensation ( $\alpha = 0.91$ ), Masking ( $\alpha = 0.85$ ), and Assimilation ( $\alpha = 0.92$ ) factors. Correlations between each factor and the total score were calculated using item-total correlation, and the corrected factor-total correlations in the total sample were: Compensation  $\alpha = .705$ ; Masking  $\alpha = .483$ , Assimilation  $\alpha = .627$ .

Test-retest reliability was calculated in a subsample of 30 autistic participants, who completed the CAT-Q again online three months after initial testing. This subsample was significantly older on average than the total autistic sample ( $F[1, 331] = 12.61, p < .001$ ; mean difference = 9.23 years [SE = 2.6]). However, there was no significant difference in the distribution of genders (Male, Female, Other Gender, and not stated) ( $X^2[4] = 1.66, p = .80$ ), and no significant difference in mean Total BAPQ score ( $t[299] = 0.55, p = .59$ ) between this subsample and the total autistic sample. Good stability was found, as measured by Pearson's  $r$  and intra-class correlations (ICC) for the total scale and the Compensation factor, while moderate stability was found for the Masking and Assimilation factors (Table 4.7). No significant difference between scores at Time 1 and Time 2 was found ( $F[1, 29] = 0.23, p = 0.63$ ).

Table 4.7. Test-retest reliability of CAT-Q Total score and factors in autistic subsample (N = 30)

	Pearson's r	ICC[C,1]	95% CI
Total CAT-Q	0.77	0.77	0.73, 0.79
Compensation Factor	0.78	0.77	0.72, 0.82
Masking Factor	0.70	0.70	0.63, 0.76
Assimilation Factor	0.73	0.73	0.67, 0.78

#### *4.4.4.2 Validation*

Correlations were performed between the total and factor CAT-Q scores, and scores on autistic-like traits (total BAPQ score and subscale scores), social anxiety (total LSAS score), wellbeing (total WEMWBS score), generalised anxiety (total GAD-7 score), and depression (total PHQ-9 score) in order to investigate convergent validity. Results in the autistic and non-autistic samples are detailed in Table 4.8. Generalised anxiety and depression scores were available for autistic participants only, as data were collected at separate timepoints.

The total CAT-Q score and all CAT-Q factors were significantly positively correlated with autistic-like traits and social anxiety in autistic and non-autistic samples, with the exception of the Masking factor, which was not significantly related to autistic-like traits in the autistic sample. The total CAT-Q and all CAT-Q factors were significantly negatively correlated with wellbeing in the non-autistic sample; however, in the autistic sample, only total CAT-Q and the Assimilation factor were significantly negatively correlated with wellbeing. Depression and generalised anxiety were only measured in the autistic sample; both of these were significantly positively correlated with total CAT-Q and all its factors.

Table 4.8. Correlations between CAT-Q Total and factor scores and autistic traits (BAPQ), social anxiety (LSAS), wellbeing (WEMWBS), depression (PHQ), and generalised anxiety (GAD) for the autistic (N = 306) and non-autistic (N= 400) subsamples.

	Total BAPQ	BAPQ: Aloof	BAPQ: Pragmatic Language	BAPQ: Rigidity	Total LSAS	WEMWBS	PHQ	GAD
<b>Autistic</b>								
CAT-Q Total	0.34***	0.24***	0.33***	0.28***	0.44***	-0.16*	0.28***	0.35***
Compensation	0.21***	0.08	0.27***	0.18**	0.30***	-0.02	0.18**	0.25***
Masking	-0.03	-0.07	-0.03	0.01	0.19**	-0.02	0.16**	0.20***
Assimilation	0.72***	0.63***	0.62***	0.54***	0.60***	-0.37***	0.35***	0.41***
<b>Non-Autistic</b>								
CAT-Q Total	0.67***	0.58***	0.56***	0.54***	0.60***	-0.43***	-	-
Compensation	0.54***	0.42***	0.52***	0.44***	0.46***	-0.31***	-	-
Masking	0.32***	0.24***	0.24***	0.32***	0.35***	-0.24***	-	-
Assimilation	0.78***	0.77***	0.62***	0.59***	0.69***	-0.53***	-	-

\*p < .05, \*\*p < .01, \*\*\*p < .001



## **4.5. Discussion**

### **4.5.1 Discussion of findings**

This study psychometrically tested the newly developed Camouflaging Autistic Traits Questionnaire (CAT-Q) in autistic and non-autistic samples. Exploratory factor analysis identified a three-factor structure, consisting of Compensation (strategies used to compensate for social and communication difficulties), Masking (strategies used to present a non-autistic or less autistic persona to others), and Assimilation (strategies used to fit in to uncomfortable social situations). The structure of the refined, 25-item CAT-Q (see Appendix 4) was corroborated through confirmatory factor analysis, and measurement invariance was established between all four groups, suggesting that the CAT-Q is appropriate for use in clinical and non-clinical populations, and that scores can be compared between males and females. The CAT-Q demonstrated acceptable to good internal consistency and reliability over a period of three months. However, as the test-retest reliability analyses were conducted only in the older autistic sample, we report these findings as preliminary and suggest future research replicates these analyses in more diverse autistic and non-autistic samples.

The factors of Compensation and Masking reflect the two components of camouflaging proposed in Chapter 3. The third factor ('Assimilation') represents attempts to blend in to social situations in which the individual is uncomfortable, without letting others see this discomfort. These motivations for camouflaging have been described in responses from participants in Chapter 3 as well as in previous research, although not extensively (Tint & Weiss, 2017). The strategies within the Assimilation factor included avoiding social situations or managing them with the help of others, alongside items reflecting the feeling of not being one's self during interactions. The factor reflects comments made by autistic adults, as reported in Chapter 3, that they often choose to camouflage in situations where they do not know others well, whereas they feel free to be themselves while alone or with trusted others.

The model tested here provided a good fit in both autistic and non-autistic samples. Total CAT-Q score was positively correlated with autistic-like traits in both samples, suggesting that the higher level of autistic-like traits a person has, the more they will camouflage those traits, regardless of autism diagnosis. As high-level, successful camouflaging may result in missed clinical diagnoses (Tierney, Burns & Kilbey, 2016), the CAT-Q could be used to identify camouflaging behaviours in individuals considered at-risk for autism, but who do not currently meet diagnostic criteria. Measurement invariance analyses also demonstrated that the underlying structure of the CAT-Q is comparable in male and female autistic and non-autistic samples; in other words, the CAT-Q measures the same latent constructs in both genders and diagnostic groups. However, autistic participants scored significantly higher than non-autistic participants on the total CAT-Q and all three factors in the exploratory sample, demonstrating that the CAT-Q measures behaviours that are more common in individuals who have been diagnosed with autism spectrum conditions.

The Masking factor demonstrated the smallest difference between autistic and non-autistic samples in this analysis, suggesting that there may be more overlap between these two groups than for the other factors. Masking may be less specific to autism than the other components of camouflaging, and may reflect more general self-presentation or impression-management strategies applied to autistic characteristics. However, further research is needed to directly compare masking strategies and other self-presentation strategies in autistic and non-autistic samples to determine similarities and differences. In the autistic sample, masking was not significantly correlated with autistic-like traits, suggesting that it may be a response to the identification of being autistic rather than to the presence of specific autistic characteristics; in contrast, a significant positive relationship between the two was observed for the non-autistic sample, suggesting that the two groups may have been using masking strategies in response to different motivations.

Previous research suggested that camouflaging in autistic adults may be associated with poor mental health outcomes, especially anxiety, depression, and generally poor quality of life (Cage, Di Monaco & Newell, 2017; Lai et al., 2017). The positive correlations between the CAT-Q and measures of social anxiety, anxiety, and depression, and the negative correlation between the CAT-Q and wellbeing, support this idea and offer convergent validation of the measure. Greater total camouflaging appears to be associated with poorer mental health outcomes overall, although interestingly the Compensation and Masking factors were not significantly associated with wellbeing in the autistic sample. This may reflect individual differences in the impact or success of camouflaging; previous research found that associations between camouflaging and negative outcomes were stronger for autistic men than women (Lai et al., 2017). Further assessment of gender differences in camouflaging behaviours in this sample is reported in Chapter 5.

#### 4.5.2 Strengths and Limitations

A significant strength of this approach is that the items were developed based on information from autistic people themselves, describing their own experiences of camouflaging. This ensures that behaviours which may not have been previously identified as part of social camouflaging by non-autistic clinicians and researchers can be measured. The CAT-Q can be used in combination with observed behavioural and cognitive measures of camouflaging to assess all aspects of this complex phenomenon. It may also have clinical implications to identify levels of camouflaging along with other clinical information, including those derived from current autism diagnostic measures, to enhance the sensitivity and specificity of clinical diagnosis, formulation, and support planning; however, the clinical utility requires further clinical research to establish.

In addition, the CAT-Q does not require an official diagnosis of an autism spectrum condition for camouflaging behaviours to be assessed, as the underlying structure shows invariance between autistic and non-autistic populations. This addresses some issues in current autism research, especially that criteria for autistic participants may be based on

an overly restricted and potentially inaccurate operational definition of autism. Even if autism diagnostic criteria change in the future, use of the CAT-Q should not vary between clinical and non-clinical groups. The CAT-Q has demonstrated measurement invariance between male and female participants, enabling comparison across genders in future research.

This study is not without its limitations. First, although the BAPQ has demonstrated validity and reliability in clinical and non-clinical samples (Ingersoll et al., 2011; Nishiyama et al., 2014), it was developed for use with relatives of those with an autism diagnosis. Therefore we are cautious about using BAPQ scores as a measure of autistic traits in clinical and general population samples (Piven & Sasson, 2014). In future, to accurately examine how camouflaging is related to autistic traits, the CAT-Q should be compared to a measure of autistic traits which has been explicitly developed for use in autistic populations, for example, the severity score of the ADOS-2.

Second, no behavioural measure of social ability was included in the study. Individuals with greater social skills are less likely to need to camouflage in the first place, and may do so more effectively than those with poorer social skills. Further research is needed to identify the extent to which social skills predict camouflaging behaviours, which will have implications regarding prevailing social skills training in autistic individuals. There was also no objective validation of self-reported autism diagnosis. However, only participants who reported receiving a diagnosis from a healthcare professional were included in the autistic sample. Third, responses on the PHQ-9 and GAD-7 were not available for non-autistic participants as these data were collected as part of a separate project; the relationship between camouflaging and depression and anxiety should therefore also be examined in non-autistic adults.

Fourthly, the self-report CAT-Q only measures individuals' own reflections/perceptions of their camouflaging behaviours, and is thus limited in its use to those who are able to reflect on their own behaviours and provide insight to their motivations. The CAT-Q may

therefore not be useful for autistic individuals with language difficulties or intellectual disability. By combining this measure with behavioural or informant-report measures of camouflaging, estimates of camouflaging behaviours in those who have less insight or ability to communicate it can also be obtained.

Fifthly, the CAT-Q was created mainly based on reflections from autistic adults, and was psychometrically examined and validated in the present adult sample, in which a substantial proportion of the autistic participants received their diagnoses in adulthood instead of childhood. Hence, although the validity and potential clinical utility are likely ensured in autistic adults, in particular those who are diagnosed in adulthood (Lai & Baron-Cohen, 2015), it is still unclear whether the psychometric properties and potential utilities hold for adolescents and older children, with or without autism, or for those with intellectual disability. Further testing of the CAT-Q in samples of varying ages and abilities, including adults who were diagnosed in childhood, should be conducted to measure its factor structure, validity and reliability across these groups. As the confirmatory sample contained more males than females, these analyses should also be replicated in a gender-matched sample. Finally, although the validation of the CAT-Q supports previous research suggesting camouflaging is associated with poorer wellbeing and mental health outcomes, only correlational relationships were identified. Longitudinal or intervention studies are necessary to confirm the causal nature of these relationships, and to establish the mechanisms and individual characteristics that may predict outcomes of camouflaging.

#### 4.5.3 Conclusions and Next Steps

The CAT-Q is a valid and reliable self-report measure of adults' social camouflaging behaviours, suitable for use in autistic and non-autistic male and female populations. It can therefore be used to directly compare camouflaging behaviours by males and females with and without autism, to determine whether camouflaging forms part of the female autism phenotype. This analysis is described in Chapter 5.

It is also important to compare the CAT-Q to existing measures of camouflaging, namely the discrepancy between internal and external autistic experiences. Chapter 6 describes the comparison of self- and parent-report CAT-Q scores, and the discrepancy between autistic traits and autistic behavioural presentation, for a sample of autistic teenagers. The relationship between camouflaging and social skills is also explored in this chapter. The validation of the CAT-Q as a reliable measure of camouflaging additionally enables some initial exploration of the characteristics associated with camouflaging between autistic individuals. Potential cognitive and predictors of total camouflaging and individual camouflaging factors are examined and reported in Chapter 7.

The CAT-Q can be used in research settings to quantify camouflaging behaviours and compare between groups; in clinical settings as a potential screening tool for individuals who may be missed under current autism diagnostic criteria because they camouflage; and by autistic and non-autistic people to aid identification of beneficial or harmful behaviours they use in social situations. Further validation of the CAT-Q in more diverse samples is encouraged in the future.

## CHAPTER 5: GENDER DIFFERENCES IN CAMOUFLAGING USING THE CAT-Q (STUDY 4)

### 5.1 Abstract<sup>5</sup>

Following the development of the Camouflaging Autistic Traits Questionnaire (CAT-Q) to measure self-reported camouflaging behaviours in adults, gender differences in camouflaging were explored. Age and autistic-like traits were controlled for, and an interaction between gender and diagnostic status was found: autistic females demonstrated higher total camouflaging scores than autistic males (partial  $\eta^2 = .08$ ), but there was no camouflaging gender difference for non-autistic people. Autistic females scored higher than males on two of the three CAT-Q subscales: Masking (partial  $\eta^2 = .05$ ), and Assimilation (partial  $\eta^2 = .06$ ), but not on the Compensation subscale. No differences were found between non-autistic males and females on any subscale. No differences were found between non-binary individuals and other genders in either autistic or non-autistic groups, although samples were underpowered. These findings support previous observations of greater camouflaging in autistic females than males, and demonstrate for the first time no self-reported gender difference in non-autistic adults. Camouflaging may be considered part of the female autism phenotype, although autistic males may also camouflage to a greater extent than non-autistic individuals.

### 5.2 Introduction

As described in Chapter 1, camouflaging of autistic characteristics, especially during clinical assessments or outside of the home, has been proposed as one way in which autistic girls and women may be missed by assessments that focus on 'typical' autism behaviours (Kopp & Gillberg, 1992). In support of this hypothesis, several studies using

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discrepancy approaches to measure camouflaging have found greater discrepancy between internal autistic status and external behavioural presentation in females than in males (Lai et al., 2017, 2018). However, there has been limited examination of this hypothesis using observational/reflective approaches. Some studies suggest greater use of camouflaging strategies in autistic females (Cassidy, Bradley, Shaw, & Baron-Cohen, 2018; Dean, Harwood, & Kasari, 2017); others have found no gender difference (Cage & Troxell-Whitman, 2019).

Both discrepancy and observational/reflective approaches to measuring camouflaging have strengths and weaknesses; through a combination of approaches we can obtain the most accurate conceptualisations of gender differences in autistic camouflaging. Chapter 4 of this thesis described the development of a reliable and valid self-report measure of camouflaging following the observational/reflective approach. The current chapter details its use to measure camouflaging behaviours in autistic men and women, adding substantially to the current understanding of gender differences in autism through one of the largest samples so far. There has also been limited research into the extent of camouflaging in individuals who do not identify as either male or female; this study seeks to address this by including non-binary individuals in analyses of gender differences.

In addition, only a minority of previous research into gender differences in camouflaging has included non-autistic comparison groups (Cassidy et al., 2018; Dean et al., 2017; Lai et al., 2018; Parish-Morris et al., 2017). If gender differences in camouflaging in the hypothesised direction are found in autistic individuals, but not in non-autistic individuals, this supports the role of camouflaging in the female autism phenotype. Camouflaging would represent a behaviour that is most commonly seen in autistic females, perhaps due to the unique social demands of being female and autistic (Kreiser & White, 2014). In contrast, if similar gender differences are found in non-autistic males and females, this suggests that gender differences in camouflaging may reflect general social expectations for females to be more sociable and amendable than males, which apply equally to



autistic and non-autistic females. Autistic individuals of any gender may camouflage more than non-autistic individuals (as demonstrated in Chapter 4), but any gender differences may not be unique to autism, as was explored in Chapter 2. For this reason, it is essential that research comparing camouflaging across genders in autism also accounts for gender differences in non-autistic individuals.

Differences in camouflaging levels across genders may lead to differences in risk of mental health problems and reduced wellbeing (Lai et al., 2017); it is therefore important to assess how much autistic individuals of different genders are camouflaging in everyday life, and compare this to camouflaging in non-autistic individuals. Camouflaging, like autistic traits, likely exists on a continuum across the entire population. However, individuals with higher levels of autistic characteristics are also likely to camouflage these more, as was demonstrated in Chapter 4, and so higher levels of camouflaging in one gender may simply reflect more autistic characteristics to camouflage. As a supplementary analysis, and to thoroughly test the hypothesis that autistic females camouflage more than males because of differences in social expectation and/or behavioural presentation (Cage & Troxell-Whitman, 2019; Lai et al., 2011), it is also important to control for autistic traits, separately to assessing the extent of real-life camouflaging across genders. There may be age-related differences in the extent to which individuals camouflage, based on social demands, experience, mental health, and other factors (Cage & Troxell-Whitman, 2019; see also Chapter 3), and so age should be included in comparisons of camouflaging across groups and genders.

The present study had two key aims. First, this was the first study to test gender differences in self-reported camouflaging behaviours in both autistic and non-autistic adults, including people of non-binary gender. We hypothesised that autistic females would camouflage more than autistic males, following the predictions of the female autism phenotype hypothesis and in support of some previous research. Gender differences for non-binary autistic individuals' camouflaging, or that of any non-autistic participants, were not hypothesised as there has been no prior research examining this.

Second, we also aimed to examine whether gender differences in camouflaging of autistic traits reflect underlying levels of autistic traits, and whether this is comparable across diagnostic groups. Autistic traits were added as a covariate in supplementary analyses, to determine whether any gender differences in real-life identified in autistic or non-autistic groups remained once variation in autistic traits between genders was controlled for.

## **5.3 Methods**

### **5.3.1 Participants**

Autistic and non-autistic participants were recruited through social media, through the Cambridge Autism Research Database, and through word-of-mouth. Participants self-reported an official autism diagnosis from a qualified healthcare professional and were asked to detail the label of diagnosis (e.g. Autism, Asperger's Syndrome, Autism Spectrum Disorder), the age they were diagnosed, and the type of healthcare professional who diagnosed them. Those who reported being self-diagnosed were automatically excluded from the study and did not complete any further questions. Gender was measured by asking participants to report the gender they identified as (male, female or 'other gender'). Characteristics of the sample and mean scores on all variables are included in Table 5.1.

Table 5.1 Sample characteristics

	Total Sample	Autistic Sample			Non-Autistic Sample		
		Female	Male	Non-Binary	Female	Male	Non-Binary
N	778	182	108	16	252	193	27
Age (SD)	34.56 (14.89)	39.91 (12.75)	46.68 (13.98)	33.50 (11.74)	29.86 (13.40)	30.94 (14.78)	26.52 (10.74)
Highest level of education (%)		Secondary: 36 Undergraduate: 30 Postgraduate: 33 Not Specified: 1	Secondary: 35 Undergraduate: 28 Postgraduate: 35 Not Specified: 2	Secondary: 66 Undergraduate: 17 Postgraduate: 17 Not Specified: 0	Secondary: 47 Undergraduate: 28 Postgraduate: 25 Not Specified: 0	Secondary: 47 Undergraduate: 30 Postgraduate: 23 Not Specified: 0	Secondary: 86 Undergraduate: 7 Postgraduate: 7 Not Specified: 0
Nationality (%)		British: 53 N. American: 23 European: 15 Other: 6 Not Specified: 3	British: 63 N. American: 20 European: 8 Other: 8 Not Specified: 1	British: 38 N. American: 44 European: 12 Other: 6 Not Specified: 0	British: 43 N. American: 28 European: 17 Other: 8 Not Specified: 4	British: 48 N. American: 29 European: 12 Other: 6 Not Specified: 5	British: 37 N. American: 40 European: 3 Other: 13 Not Specified: 7

	Total Sample	Autistic Sample			Non-Autistic Sample		
		Female	Male	Non-Binary	Female	Male	Non-Binary
ASC Diagnosis (%)	N.A.	Asperger's: 67 Autism: 19 ASD: 11 PDD-NOS: 3	Asperger's: 74 Autism: 18 ASD: 6 PDD-NOS: 2	Asperger's: 56 Autism: 19 ASD: 25	N.A.	N.A.	N.A.
Age at ASC Diagnosis (SD)	N.A.	34.07 (13.13)	37.92 (15.99)	23.76 (13.08)	N.A.	N.A.	N.A.
Who gave ASC Diagnosis (%)	N.A.	Psychologist: 53 Psychiatrist: 35 Other doctor <sup>a</sup> : 2 Other <sup>b</sup> : 9	Psychologist: 53 Psychiatrist: 36 Other doctor <sup>a</sup> : 3 Other <sup>b</sup> : 8	Psychologist: 44 Psychiatrist: 50 Other <sup>b</sup> : 6	N.A.	N.A.	N.A.
CAT-Q Total (SD)	104.16 (28.54)	124.35 (23.27)	109.64 (26.50)	122.00 (17.12)	90.87 (27.67)	96.89 (24.22)	109.44 (27.20)
CAT-Q Comp (SD)	33.37 (12.73)	41.85 (11.11)	36.81 (12.14)	43.50 (9.89)	27.18 (11.50)	30.06 (10.92)	35.48 (11.32)
CAT-Q Mask (SD)	35.80 (9.51)	37.87 (10.54)	32.90 (10.57)	36.06 (8.78)	34.69 (9.05)	36.34 (8.13)	38.70 (7.61)

	Total Sample	Autistic Sample			Non-Autistic Sample		
		Female	Male	Non-Binary	Female	Male	Non-Binary
CAT-Q	34.94	44.63	39.93	39.88	29.00	30.48	35.26
Assim (SD)	(12.20)	(7.82)	(11.26)	(6.43)	(11.73)	(10.33)	(12.11)
BAPQ Total	3.63	4.37	4.17	4.30	3.10	3.24	3.53
(SD)	(0.91)	(0.63)	(0.84)	(0.50)	(0.73)	(0.72)	(0.80)

Note. ASC = Autism Spectrum Condition; PDD-NOS = Pervasive Developmental Disorder, Not Otherwise Specified; CAT-Q = Camouflaging Autistic Traits Questionnaire; CAT-Q Comp = Compensation subscale; CAT-Q Mask = Masking subscale; CAT-Q Assim = Assimilation subscale; BAPQ = Broader Autism Phenotype Questionnaire. <sup>a</sup> Including family doctor/general practitioner, paediatrician, and multi-disciplinary team. <sup>b</sup> Including speech and language therapist, school, and nurse practitioner.

Power analysis using G\*Power (Faul, Erdfelder, Lang, & Buchner, 2007) determined that a minimum sample of 54 per group would be necessary to detect medium-sized differences (partial  $\eta^2 = 0.5$ ) in an ANCOVA between autistic and non-autistic males, females, and non-binary individuals' camouflaging score while controlling for age and autistic-like traits. Individuals who identified as non-binary (neither male nor female; N = 43; 16 with autism, 27 without autism) were included in analyses, but results are presented and discussed as preliminary only, as this sample was not well-powered enough to detect the predicted effect sizes. The final sample included 778 participants in total (see Table 5.1). An additional 53 individuals did not report their gender, and were not included in any analyses.

### 5.3.2 Measures

Camouflaging of Autistic Traits Questionnaire (CAT-Q).

This is a 25-item self-report questionnaire measuring strategies used to camouflage autistic traits and comprising three factors (Compensation, Masking, and Assimilation) which are summed up to produce a total score from 25 to 175, with higher scores representing greater levels of camouflaging. The CAT-Q has been validated in autistic and non-autistic male and female samples, and has demonstrated measurement equivalence across gender and diagnostic groups (see Chapter 4). Internal consistency in this sample was high ( $\alpha = 0.94$ ).

Broad Autism Phenotype Questionnaire (BAPQ; Hurley, Losh, Parlier, Reznick, & Piven, 2007).

This is a 36-item self-report measure of traits associated with the broader autism phenotype (BAP). BAP characteristics are associated with greater genetic liability for autism, and are found across the population and at especially high levels in relatives of those with an autism diagnosis. Although it was designed as a measure of autistic-like traits in relatives of autistic people, the BAPQ serves as a good measure of autistic-like traits across the general population (Nishiyama et al., 2014). The BAPQ has good

sensitivity (Sasson, Lam, Childress et al., 2013) and specificity (Hurley et al., 2007) for the broader autism phenotype. Internal consistency in this sample was high ( $\alpha = 0.96$ ). Minimum score is 0, maximum score is 6 when scores are averaged across the total questionnaire.

### 5.3.3 Procedure

Participants followed an online link to the study, hosted by Qualtrics, where they read the information sheet and completed an informed consent form. They completed demographic questions and then the CAT-Q and BAPQ as part of a broader battery of questionnaires, online.

Ethical approval for this study was obtained from UCL Research Ethics Committee (ID numbers 7475/002 and CEHP/EP/2016/0004). Informed consent was obtained from all individual participants in this study.

### 5.3.4 Analysis

All analyses were performed in R (R Core Team, 2013).

The following analyses of covariance were performed to test the effect of gender and diagnostic group, and the interaction between gender and diagnostic group, on CAT-Q total and on each of its three subscales (Compensation, Masking, and Assimilation). Initial analyses were performed in the total sample, with follow-up analyses performed in the autistic and non-autistic samples, and in male, female, and non-binary subsamples, separately. Bonferroni corrections were used for all follow-up analyses to account for multiple comparisons, with a corrected significance value of  $\alpha = .005$ . Partial eta squared was used as a measure of effect size for MANCOVA and ANCOVA (where values under .04 = small effect, values of .04 - .10 = moderate effect, and values above .14 = large effect), and Cohen's *d* used as a measure of effect size for planned comparison tests (where values under 0.4 = small effect, values of 0.5 – 0.7 = moderate effect, and values above 0.8 = large effect). Both effect sizes were interpreted following Cohen (1988).

Firstly, main and interaction effects of gender and diagnostic group were examined while controlling for participant's age, through analysis of covariance (ANCOVA) for Total CAT-Q and MANCOVA for CAT-Q subscales. Univariate ANCOVAs were run separately in autistic and non-autistic groups to examine main effects of gender (with planned comparisons between each of the three genders when significant main effects were found), and in each gender to examine main effects of diagnostic group. These analyses aimed to identify the real-life levels of camouflaging across genders and groups.

Secondly, all analyses were repeated while controlling for participants' age and autistic traits (BAPQ total score). These analyses aimed to identify whether gender and group differences in camouflaging simply reflect differences in the amount of autistic characteristics that need to be camouflaged, or are a result of other factors.

#### **5.4 Results**

Two-way ANOVA comparing age revealed main effects of diagnostic group (autistic participants were significantly older than non-autistic participants ( $F[1, 785] = 52.40, p < .001, \text{partial } \eta^2 = .06$ ), gender ( $F[2, 785] = 12.02, p < .001$ ), and an interaction between diagnostic group and gender ( $F[2,785] = 4.64, p = .01$ ). Follow-up comparisons indicated that in the autistic sample, males were older than females ( $p < .001$ ) and non-binary individuals ( $p < .001$ ); there was no difference between females' and non-binary participants' ages. In the non-autistic sample, there were no gender differences in age. Autistic participants (mean BAPQ score = 4.30, SD = 0.71) had significantly higher levels of autistic-like traits than non-autistic participants (mean BAPQ score = 3.18, SD = 0.74;  $t(777) = 20.55, p < .001$ ).

Gender distributions on unadjusted Total CAT-Q scores in autistic and non-autistic samples are presented in Figure 5.1. Distributions on the CAT-Q subscales are presented in Figure 5.2 (Appendix 5).



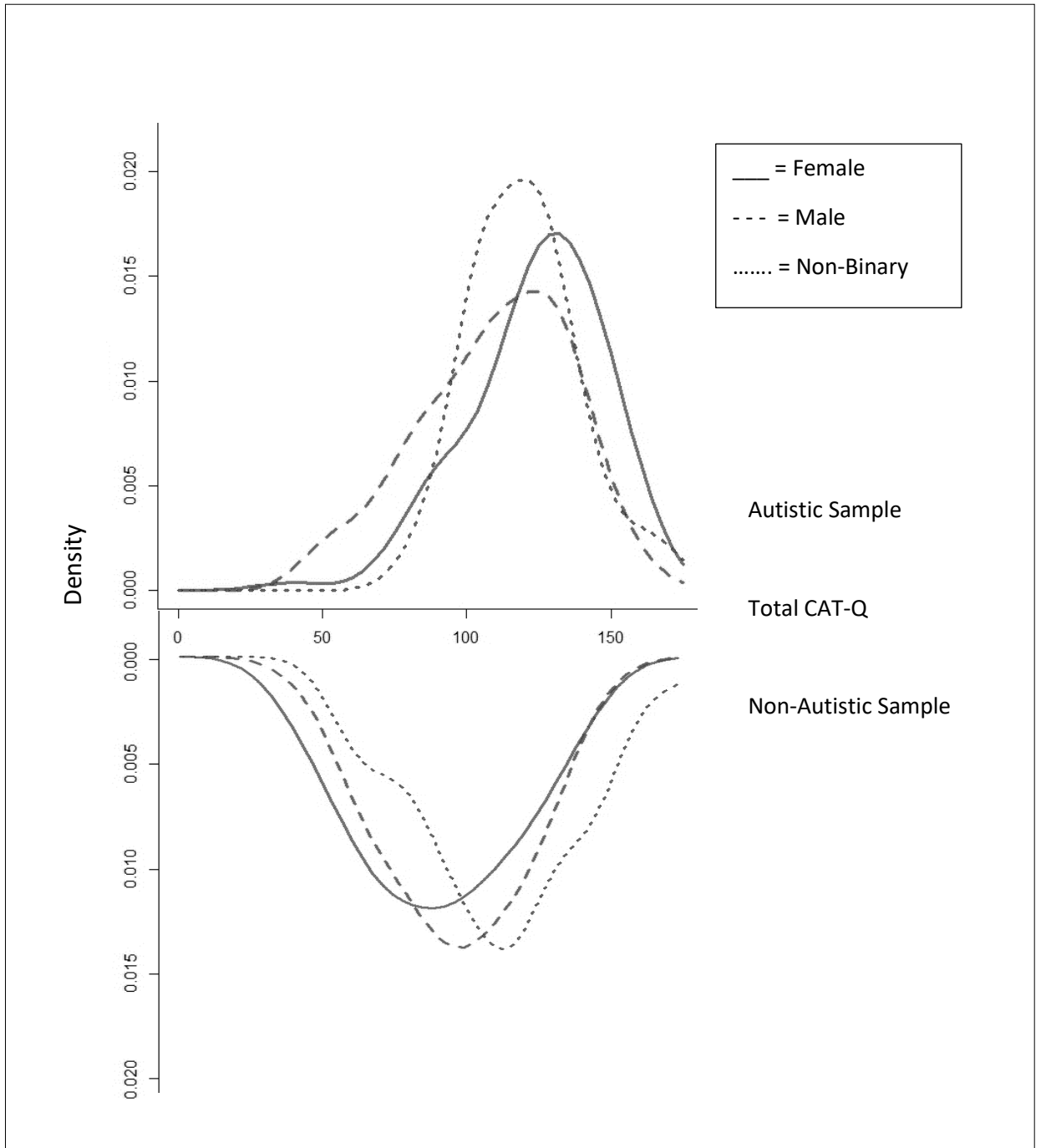


Figure 5.1. Distribution of unadjusted the Total CAT-Q scores for Autistic (above x-axis) and Non-Autistic (below x-axis) males, females, and non-binary participants. Note: minimum score is 25, maximum score is 175. 'Density' represents the proportion of participants in each group who scored at each level of the CAT-Q or its subscales; distributions for non-autistic samples have been reflected to allow group comparison, and still represent positive values.

### 5.4.1 Gender and Group differences with Age as a covariate

Figure 5.3 shows interactions between gender and diagnostic group for total and subscale CAT-Q scores, when age was included as a covariate. See Table 5.1 for unadjusted means for all variables.

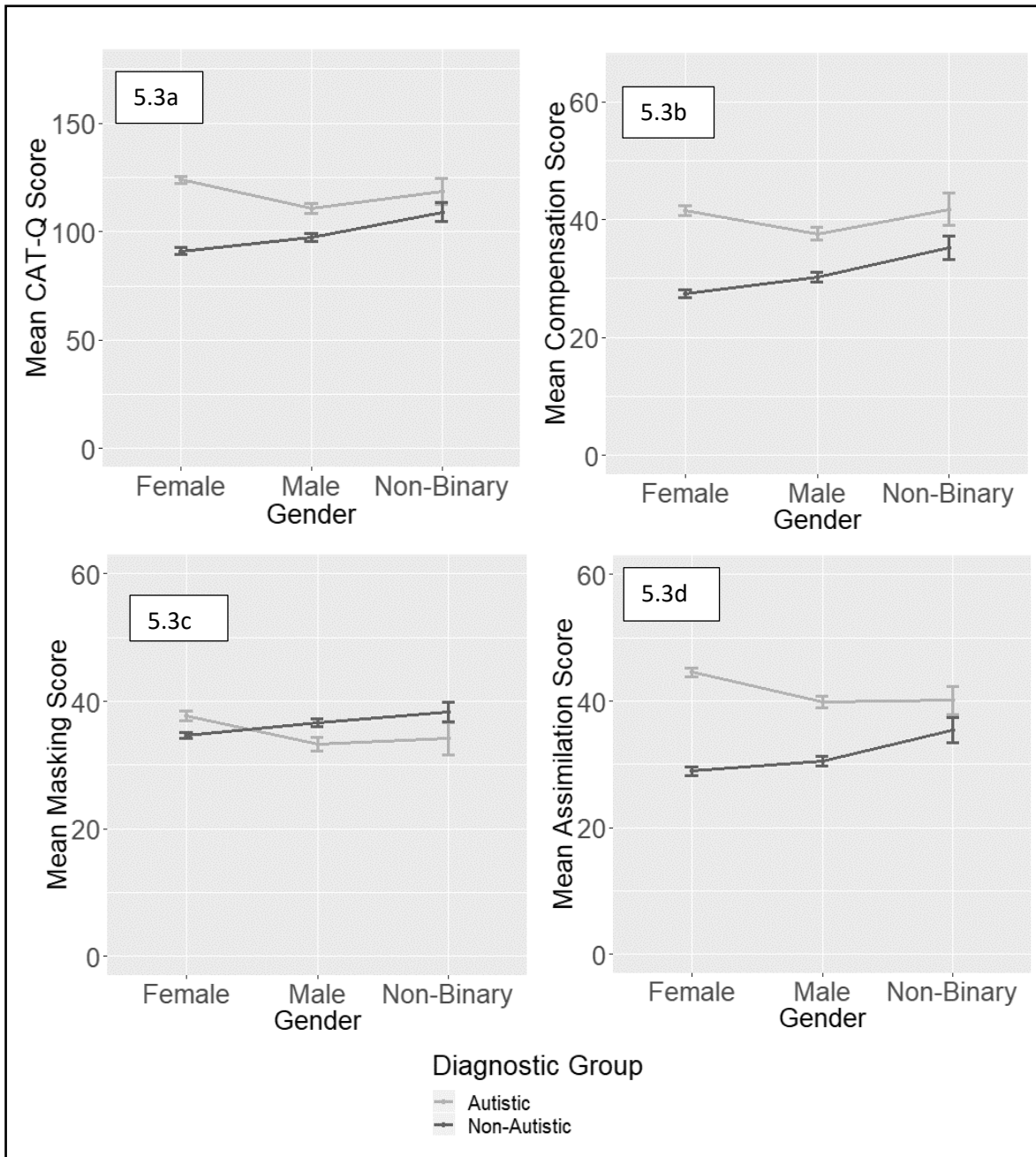


Figure 5.3. Mean scores on the Total CAT-Q (a) and its Compensation (b), Masking (c), and Assimilation (d) subscales by diagnostic group and gender, controlling for age. Autistic participants are in grey, non-autistic participants are in black. Note: range for Total CAT-Q is 25-175, range for Compensation is 9-63, range for Masking and Assimilation is 8-56.

#### 5.4.1.1 Total CAT-Q score

The first ANCOVA revealed no main effect of gender ( $F[3,781] = 0.23, p = .63$ ), a significant main effect of diagnostic group, with autistic participants scoring higher than non-autistic participants ( $F[3,781] = 232.24, p < .001$ ), and an interaction between gender and diagnostic group for Total CAT-Q score ( $F[3,781] = 26.27, p < .001$ ). The assumption of equality of error variance was met for this model.

In order to further explore this interaction, follow-up ANCOVA in the autistic sample revealed a main effect of gender ( $F[2, 306] = 9.67, p < .001, \text{partial } \eta^2 = .06$ ), with pairwise comparisons indicating autistic females scored higher than males ( $p < .001, d = .65$ ), and no difference between non-binary individuals and males or females. In the non-autistic sample, follow-up ANCOVA demonstrated a main effect of gender ( $F[2, 478] = 8.98, p < .001, \text{partial } \eta^2 = .04$ ), with pairwise comparisons indicating non-autistic non-binary individuals scored higher than females ( $p < .001, d = .73$ ) but not males. Non-autistic males did not score differently to any other gender at the corrected alpha level.

Follow-up ANCOVAs were performed to examine diagnostic group differences separately for each gender. Autistic females scored higher than non-autistic females ( $F[1, 437] = 218.95, p < .001, \text{partial } \eta^2 = .34$ ). Autistic males scored higher than non-autistic males ( $F[1, 300] = 29.16, p < .001, \text{partial } \eta^2 = .09$ ). No difference was found between autistic and non-autistic non-binary participants ( $F[1, 46] = 2.96, p = .09, \text{partial } \eta^2 = .06$ ).

#### 5.4.1.2 CAT-Q Subscales

Overall for the three subscales, MANCOVA revealed no main effect of gender ( $F[3, 781] = 1.70, p = .19$ ), a main effect of diagnostic group with autistic participants scoring higher than non-autistic participants ( $F[3, 781] = 241.12, p < .001$ ), and an interaction between gender and diagnostic group ( $F[3, 781] = 15.71, p < .001$ ). The assumption of equality of covariance matrices was not met for this model, therefore Pillai's Trace was used as a robust multivariate statistic.

Follow-up ANCOVA in the autistic sample revealed a significant multivariate effect of gender (Pillai's Trace = .02,  $F [6, 604] = 4.23$ ,  $p < .001$ , partial  $\eta^2 = .04$ ), and univariate effects of gender in the Masking ( $F [2, 306] = 6.29$ ,  $p = .002$ , partial  $\eta^2 = .04$ ) and Assimilation ( $F[2, 306] = 783.25$ ,  $p < .001$ , partial  $\eta^2 = .06$ ) subscales. No main effect of gender was found for the Compensation subscale when adjusting for the corrected alpha ( $F[2, 306] = 4.07$ ,  $p = .02$ , partial  $\eta^2 = .03$ ). Pairwise comparisons were conducted to assess gender differences in the Masking and Assimilation subscales. Autistic females scored higher than autistic males on the Masking subscale ( $p = .001$ ,  $d = .43$ ) and the Assimilation subscale ( $p < .001$ ,  $d = .51$ ). No other differences were significant at the corrected alpha level.

In the non-autistic sample, follow-up ANCOVA demonstrated a significant multivariate effect of gender (Pillai's Trace = 0.44,  $F[6, 948] = 3.52$ ,  $p = .002$ , partial  $\eta^2 = .02$ ), and univariate effect of gender for the Compensation subscale only ( $F[2, 478] = 9.21$ ,  $p < .001$ , partial  $\eta^2 = .04$ ). Pairwise comparisons revealed that non-autistic males scored higher than females ( $p = .005$ ,  $d = .23$ ), and that non-binary participants scored higher than females ( $p < .001$ ,  $d = .72$ ) on Compensation.

Follow-up ANCOVAs were conducted to examine the effect of diagnostic group separately in each gender. A main effect of diagnostic group was found in females (Pillai's Trace = .43,  $F[3, 433] = 108.60$ ,  $p < .001$ , partial  $\eta^2 = .43$ ), with autistic females scoring higher than non-autistic females on Compensation ( $F[1, 437] = 212.28$ ,  $p < .001$ , partial  $\eta^2 = .33$ ), Masking ( $F[1, 437] = 24.47$ ,  $p < .001$ , partial  $\eta^2 = .05$ ), and Assimilation subscales ( $F[1, 437] = 262.38$ ,  $p < .001$ , partial  $\eta^2 = .38$ ). A main effect of diagnostic group was also found in males (Pillai's Trace = .25,  $F[3, 296] = 32.82$ ,  $p < .001$ , partial  $\eta^2 = .25$ ), and autistic males scored higher than non-autistic males on the Compensation ( $F[1, 300] = 37.89$ ,  $p < .001$ , partial  $\eta^2 = .11$ ) and Assimilation subscales ( $F[1, 300] = 52.06$ ,  $p < .001$ , partial  $\eta^2 = .15$ ). In non-binary participants, no main effect of diagnostic group was found at the corrected significance level (Pillai's Trace = .23,  $F[3, 42] = 4.20$ ,  $p = .01$ , partial  $\eta^2 = .23$ ).

## 5.4.2 Gender differences with Age and Autistic Traits as covariates

### 5.4.2.1 Total CAT-Q score

The first ANCOVA revealed no main effect of gender ( $F[3,737] = 0.01, p = .99$ ), a significant main effect of diagnostic group with autistic participants scoring higher than non-autistic participants ( $F[3,737] = 11.25, p < .001$ ), and an interaction between gender and diagnostic group for Total CAT-Q score ( $F[3,737] = 12.87, p < .001$ ). The assumption of equality of error variance was met for this model.

Figure 5.4 shows interactions between gender and diagnostic group for total and subscale CAT-Q scores, when age and autistic-like traits were included as covariates.

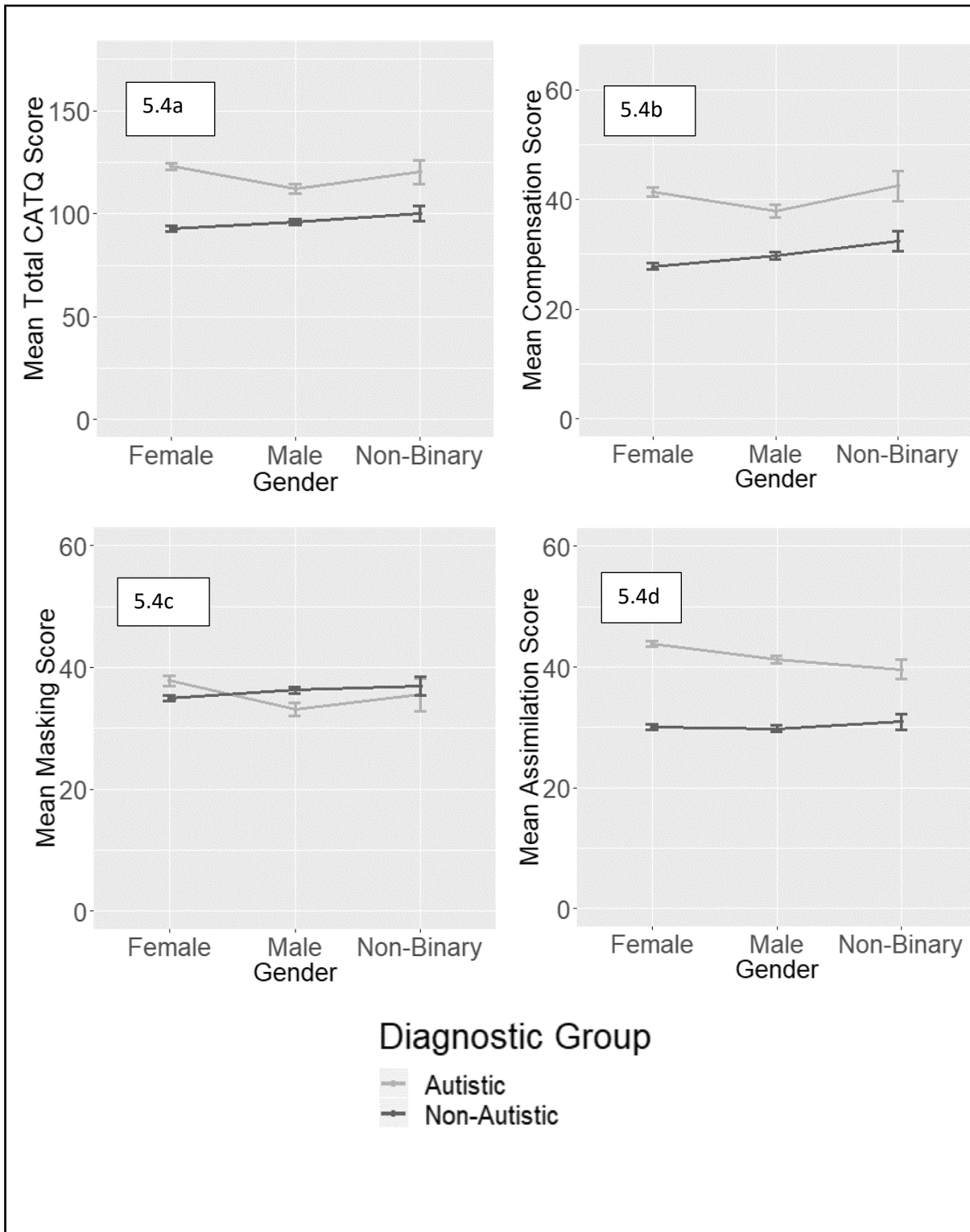


Figure 5.4. Mean scores on the Total CAT-Q (a) and its Compensation (b), Masking (c), and Assimilation (d) subscales by diagnostic group and gender, controlling for age and autistic traits. Autistic participants are in grey, Non-autistic participants in black. Note: range for Total CAT-Q is 25-175, range for Compensation is 9-63, range for Masking and Assimilation is 8-56.

Follow-up ANCOVA in the autistic sample revealed a main effect of gender ( $F[2, 299] = 6.98, p = .001, \text{partial } \eta^2 = .05$ ), with pairwise comparisons indicating autistic females scored higher than males ( $p < .001, d = .47$ ), and no difference between non-binary individuals and males or females. In the non-autistic sample, follow-up ANCOVA demonstrated no main effect of gender ( $F[2, 442] = 2.61, p = .07, \text{partial } \eta^2 = .01$ ).

Follow-up ANCOVAs were performed to examine diagnostic group differences separately for each gender. Autistic females scored higher than non-autistic females ( $F[1, 415] = 14.98, p < .001, \text{partial } \eta^2 = .04$ ). No difference was found between autistic and non-autistic males ( $F[1, 283] = 0.12, p = .73$ ) or non-binary participants ( $F[1, 39] = 0.20, p = .65$ ).

#### 5.4.2.2 CAT-Q Subscales

Overall for the three subscales, MANCOVA revealed no main effect of gender ( $F[3, 735] = 2.23, p = .08$ ), a main effect of diagnostic group with autistic participants scoring higher than non-autistic participants ( $F[3, 735] = 36.00, p < .001$ ), and an interaction between gender and diagnostic group ( $F[3, 735] = 7.70, p < .001$ ). The assumption of equality of covariance matrices was not met for this model, therefore Pillai's Trace was used as a robust multivariate statistic.

Follow-up ANCOVA in the autistic sample revealed a significant multivariate effect of gender (Pillai's Trace = .08,  $F [6, 588] = 3.81, p = .001, \text{partial } \eta^2 = .04$ ), and univariate effects of gender in the Masking ( $F [2, 299] = 6.20, p = .002, \text{partial } \eta^2 = .04$ ) and Assimilation ( $F[2, 299] = 7.50, p = .001, \text{partial } \eta^2 = .05$ ) subscales. Pairwise comparisons were conducted to assess gender differences in the Masking and Assimilation subscales. Autistic females scored higher than autistic males on the Masking subscale ( $p = .001, d = .44$ ) and the Assimilation subscale ( $p < .001, d = .40$ ). No other differences were significant at the corrected alpha level.

In the non-autistic sample, follow-up ANCOVA demonstrated no significant multivariate effect of gender (Pillai's Trace = 0.25,  $F[6, 874] = 1.86$ ,  $p = .08$ , partial  $\eta^2 = .01$ ) and so further analyses were not performed.

Follow-up ANCOVAs were conducted to examine the effect of diagnostic group separately in each gender. A main effect of diagnostic group was found in females (Pillai's Trace = .07,  $F[3, 410] = 9.99$ ,  $p < .001$ , partial  $\eta^2 = .07$ ), with autistic females scoring higher than non-autistic females on Compensation ( $F[1, 415] = 28.59$ ,  $p < .001$ , partial  $\eta^2 = .07$ ) only. A main effect of diagnostic group was also found in males (Pillai's Trace = .07,  $F[3, 278] = 6.99$ ,  $p < .001$ , partial  $\eta^2 = .07$ ), but diagnostic group differences on each subscale were not significant at the corrected alpha level. In non-binary participants, no main effect of diagnostic group was found (Pillai's Trace = .18,  $F[3, 37] = 2.66$ ,  $p = .06$ , partial  $\eta^2 = .18$ ).

## **5.5 Discussion**

### **5.5.1. Discussion of findings**

This was the first study to compare self-reported camouflaging behaviours between autistic and non-autistic men, women, and non-binary people.

A consistent finding was that autistic females had higher camouflaging scores than autistic males. Effect sizes were moderate, with the largest differences found for Total CAT-Q. This supports our hypothesis that autistic females camouflage more than males, and suggests that autistic women may use more masking strategies, and experience greater pressure than men to adapt their behaviours in order to assimilate with others. No gender difference was found on the Compensation subscale, suggesting autistic individuals of all genders may use compensatory strategies to a similar extent.

Non-binary autistic people had higher total CAT-Q scores than females when controlling for age only, suggesting that these individuals may be at particular risk of the negative outcomes associated with camouflaging. However, this difference was not found when autistic traits were controlled for, suggesting that their higher levels of camouflaging may



arise because they have more autistic traits to camouflage than females. However, the number of autistic non-binary participants in this sample was very small, and so the analyses were likely underpowered to detect small group differences.

In contrast, gender differences in non-autistic individuals were minimal, and were not maintained when autistic traits were controlled for. Non-autistic males reported slightly higher levels of camouflaging than non-autistic females, but this difference was not maintained when we controlled for levels of autistic traits. The implication is that, compared to non-autistic females, non-autistic males may use slightly more camouflaging, reflecting the fact that they have somewhat higher levels of autistic traits (Robinson et al., 2011). Non-binary non-autistic individuals had higher Total CAT-Q and Compensation scores than females, which may be accounted for by their higher mean levels of autistic traits (see Table 5.1), as these differences were not found when controlling for autistic traits. Again, however, the sample size was underpowered to detect small differences between non-binary and other participants.

Consistent group differences were found between autistic and non-autistic females, which were maintained when controlling for autistic traits. Again, this suggests that there is an interaction between being female and being autistic which produces greater camouflaging than the simple additive effects of each separately. Interestingly, differences between autistic and non-autistic males were not maintained when autistic traits were controlled for, suggesting that males across diagnostic groups camouflage their autistic characteristics to a similar extent (but that autistic males have higher levels of autistic traits, and so use more camouflaging strategies in real life). No differences between autistic and non-autistic non-binary participants were found, which is likely to reflect the small samples of each.

Overall, the pattern of gender differences suggests a relatively similar use of specific compensatory strategies in autistic males, females, and non-binary people (as measured by similar scores on the Compensation subscale), but greater use of specific Masking

and Assimilation strategies by females. One explanation for this may be differences in the gendered experiences of autistic females and males, as a product of both cultural gender norms and being held to the standards of typically developing females and males respectively (Cage & Troxell-Whitman, 2019). Kreiser and White (2014) describe an interaction between cultural, inter- and intra-personal, and biological factors affecting gender and individual development, which they suggest may produce variation in both innate autistic experience and external autistic presentation. Autistic females may perceive greater expectations to be acting similarly to typically developing peers than are felt by autistic males (Bargiela, Steward & Mandy, 2016; Dean et al., 2014), and so may camouflage to a greater extent in order to try and fit in (Kreiser & White, 2014; Tierney et al., 2016). This pattern of difference was not found in the non-autistic sample. This indicates that although the kind of intention and behavioural strategies measured by the CAT-Q are utilized across autistic and non-autistic adults, impact of gender (and theoretically, gendered contexts) is more evident and unique in the autistic compared to non-autistic population.

Participants in this study were mostly European or North American and in early/middle adulthood on average, and so mostly grew up in Westernised cultures during the 1970s, 80s, and 90s. Gender-based stereotypes and rigid gender binaries during childhood and adolescence may have contributed to this greater pressure to camouflage autistic characteristics for autistic females than males. It will be important for future research to understand why such impact is more obvious in the autistic than the neurotypical population (e.g., do autistic people of this age conform more to gender norms than their neurotypical peers?) and whether the same will be found in the younger generations, for whom conventional, binary gender norms are relaxing. It may be that the combined identities of being autistic and female result in greater stigmatisation of difference, which leads to more efforts to fit in for autistic women than other groups (Cage & Troxell-Whitman, 2019). As such, it will be a task to look at autistic individuals of all genders who develop their (autistic) identities under the current, more fluid conceptions of gender and

neurodiversity in many Westernised cultures (although it remains to be seen as to whether gender equality in society impacts social conceptions of gender; MacPhee & Prendergast, 2019; Prendergast & MacPhee, 2018), and see whether the observed gender differences remain.

Gender differences in the autistic sample remained significant even when controlling for autistic-like traits, suggesting that higher levels of camouflaging in females are not due to having more autistic traits to camouflage than males, but due to greater extent of camouflaging of the autistic traits they do have, perhaps because of greater social expectations for females than males (Bargiela, Steward & Mandy, 2016). Autistic women may experience unique and more extreme pressures than either autistic men or typically developing women, in part because of the intersection of their identities as neurodivergent and female (Cage & Troxell-Whitman, 2019), which may lead to differences in behavioural expression of autistic characteristics compared to the 'typical' male presentation. This supports suggestions that camouflaging forms part of the female phenotype of autism (Head et al., 2014; Kirkovski et al., 2013; Lai et al., 2015; Lehnhardt et al., 2015).

Camouflaging of autistic traits may be more predominant in autistic females, and may partially account for the missed and later diagnosis of autism found for many females (Duvekot et al., 2017; Dworzynski et al., 2012; Shattuck et al., 2009). Previous research has also suggested that camouflaging may lead to mental health difficulties amongst autistic females, particularly anxiety and exhaustion related to the pressures of maintaining the 'façade' (Bargiela et al., 2016; Tierney et al., 2016), and suicidal thoughts (Cassidy et al., 2018).

Our findings contradict those by Cage and Troxell-Whitman (2019), who did not find a difference between autistic males and females using the total CAT-Q score. These researchers did not control for autistic traits, therefore it is possible that male participants in their study had higher levels of autistic traits to camouflage than females, resulting in

comparable overall camouflaging scores. Further research in a range of broader samples is necessary to determine the exact nature and size of any gender differences in camouflaging, using a range of methodologies. We would also suggest that, once the literature reaches a sufficient size, meta-analysis is the best way to produce a definitive answer on the direction and size of gender differences in camouflaging using a variety of samples and methods. However, autistic males in the current study camouflaged at significantly higher levels than non-autistic males, and at equivalent levels to autistic non-binary individuals, when controlling for age only. These findings support previous research arguing that camouflaging is not an exclusively female phenomena (Cage et al., 2017; Lai et al., 2017; Livingston et al., 2018). As demonstrated in the first set of analysis, controlling only for age, autistic males and non-binary individuals are also likely to experience the negative consequences associated with camouflaging, and there may even be greater impact on mental health for men than women, possibly due to reduced experience of camouflaging and other gender-related demands (as described in Chapter 3; see also Lai et al., 2017).

### 5.5.2 Limitations and Strengths

A significant limitation of this study was that only adults who were able to access and answer the online questionnaire were included in the study. While the online nature of this study enabled participation by individuals who prefer written to spoken language, there was no representation of autistic individuals who may be unable to reflect upon and express their behaviours through written English. Furthermore, the average age of autism diagnosis was 36.25 years, suggesting that these findings may be limited to individuals who are diagnosed in adulthood. These individuals may be more likely than others to camouflage their autism, having remained unidentified for so long. Therefore, it is still an open question as to whether the findings could be generalised to autistic people who were diagnosed earlier in life (e.g. in childhood).

In addition, participants' autistic status was based on self-reported disclosure, and was not independently verified. However, participants were also asked to give details of who

gave them the diagnosis, and those who reported being diagnosed by someone other than a clinician or healthcare team were excluded from the study. More information about participants' diagnostic experiences, and other individual characteristics such as ethnicity, is important for future research to understand factors affecting variability in camouflaging.

Although we have reported all results with regards to non-binary participants, we emphasise that both autistic and non-autistic samples of non-binary individuals were underpowered to detect the expected effect sizes. This may account for the non-significance of most results regarding non-binary participants. We therefore interpret these results with caution, and suggest that further study with larger samples of non-binary individuals is conducted before any conclusions are drawn regarding non-binary camouflaging levels. Additionally, the CAT-Q has not been psychometrically validated in non-binary populations, therefore it may not be an appropriate measure to use with this group. However, as a relatively large proportion of autistic individuals identify as non-binary (Cooper, Smith, & Russell, 2018; Dewinter, De Graaf & Begeer, 2017), we believe these results are an important first step to learning more about the mechanisms and consequences of camouflaging across all genders.

Despite the aforementioned limitations, this study had multiple strengths. First, it is unique in that a psychometrically validated measure was used to assess and compare camouflaging behaviours between autistic and non-autistic males, females, and non-binary individuals. Second, it is based on the largest sample used to assess gender differences in camouflaging so far, strengthening previous findings of greater camouflaging in autistic females. Third, by controlling for age and autistic-like traits we demonstrate that self-reported camouflaging is not exclusively related to the development of typical social skills, and that gender differences in camouflaging exist for autistic individuals only.

The findings suggest that autistic women camouflage their autistic traits to a greater degree than autistic men, and therefore clinicians and other service providers should consider camouflaging when assessing women's autistic characteristics and their impact on daily functioning and wellbeing. However, autistic men and non-binary individuals also camouflage their autism at high levels, and should also be included in research looking at the consequences of camouflaging. Validated measures such as the CAT-Q may be used by individuals and in clinical settings to identify relevant camouflaging strategies and adapt behaviour as necessary to minimise negative outcomes.

### 5.5.3 Conclusions and Next Steps

This chapter offers evidence for camouflaging as part of the female autism phenotype; a behavioural expression of autism more common in autistic females, which is not currently included in diagnostic criteria or tools and so may result in underdiagnosis of females. The lack of gender differences in non-autistic adults' camouflaging suggests that camouflaging is not solely in response to gendered expectations of social behaviours, but instead represents the unique experience of being an autistic woman.

The CAT-Q can be used to examine gender differences in autistic adults; however camouflaging behaviours may develop or become more visible in adolescence. Almost nothing is known about autistic teenagers' camouflaging strategies, including the existence of any gender differences. Chapter 6 describes the use of the CAT-Q, in a self-report and parent-report format, to predict the success of camouflaging strategies in autistic teenagers, and, as a supplementary analysis, determine whether gender differences in camouflaging may relate to differences in the success of camouflaging between genders. It is also important to examine which cognitive characteristics may facilitate camouflaging. Some of those which have been proposed (e.g. theory of mind, executive function) may vary across genders, which could account for some of the gender differences observed in this chapter. Chapter 7 addresses this question by identifying the cognitive predictors of camouflaging in autistic teenagers.

## **CHAPTER 6: A COMPARISON OF CAMOUFLAGING MEASURES AND SUCCESS (STUDY 5)**

### **6.1 Abstract**

This chapter describes a study extending the CAT-Q to an adolescent sample, and further validating the CAT-Q through comparison between multiple measures of camouflaging. As part of the continued validation of the CAT-Q, its utility as a self-report measure in adolescents should be tested, as well as a parent-report version to aid identification of camouflaging behaviours earlier in life. These two versions of the CAT-Q were compared with a previously established, discrepancy measure of camouflaging (Camouflaging Discrepancy), to test concurrent validity. The relationship between all three measures of camouflaging and a proxy measure of camouflaging success (positive social impression made on others while camouflaging) was examined, in a test of convergent validity. Both self-and parent-report CAT-Q are well correlated with an established measure of camouflaging. Parent-report CAT-Q predicted positive social impression in autistic teenagers, and the relationship may be stronger in teenage girls than boys.

### **6.2 Introduction**

Chapter 4 described the development and preliminary validation of a self-report measure of camouflaging, the CAT-Q. Content validity of the CAT-Q was demonstrated through examination of the factor structure and reliability of items; and convergent validity was demonstrated through comparison with autistic traits and measures of mental health problems/wellbeing. However, further validation is important to support the use of the CAT-Q as an accurate and useful measure of camouflaging. Specifically, further concurrent validity can be examined by comparing the CAT-Q with another existing measure of camouflaging from an alternative conceptual method; the discrepancy approach, as described in Chapter 1. If both approaches to measuring camouflaging are relatively well correlated, this suggests that a latent construct of camouflaging exists, and

that a variety of methods can be used to measure this construct. In addition, discriminant validity can be demonstrated by comparing the CAT-Q to a construct which is conceptually related, but distinct, namely autism-related social difficulties (Cronbach & Meehl, 1955). Having lower levels of social difficulties (i.e. appearing less autistic in social interactions) might produce similar behavioural consequences as higher-level camouflaging. By demonstrating that these two constructs are not significantly related, we can further validate the CAT-Q as a measure of camouflaging behaviours, rather than of good social skills.

This chapter also aims to extend work with the CAT-Q into an adolescent sample. The validation work described previously in this thesis focuses on camouflaging by autistic adults, although this does not mean that only adults camouflage their autism. There has been some research into camouflaging in younger autistic individuals, which seems to support the arguments made so far that 1) camouflaging is a relatively common behaviour in autistic individuals, and 2) females camouflage their autistic traits more than males. Specifically, camouflaging behaviours have been reported by teenage girls and their parents (Cridland et al., 2014; Sedgewick, Crane, Hill, & Pellicano, 2018; Sutherland et al., 2017; Tierney et al., 2016) and higher levels of camouflaging behaviours have been observed in girls than in boys (Dean et al., 2017; Parish-Morris et al., 2017; Ratto et al., 2017).

The examination of camouflaging in younger autistic individuals also has important clinical implications. It has been suggested that camouflaging may develop, or increase to levels at which it has a greater impact on the individual, during adolescence (Hiller et al., 2014; Tierney et al., 2016). This may be due to developmental changes regarding capacity to camouflage or awareness of difference, as well as increased social demands from the individual's environment (Mandy et al., 2018; Tierney et al., 2016). In typically-developing individuals, during adolescence social relationships outside of the immediate family become more important and social behaviours increase in complexity as young



people move from childhood to adulthood (Blakemore, 2012; Tousignant, Sirois, Achim, Massicotte, & Jackson, 2017).

With the aim of further testing the validity of the CAT-Q as a measure of camouflaging of autistic traits, this chapter describes the comparison of observational/reflective and discrepancy measures of camouflaging in adolescents. There has been limited examination of camouflaging in adolescents using discrepancy approaches; therefore, this study seeks to extend the methods used by Lai and colleagues (2017) and calculate a Camouflaging Discrepancy score for autistic adolescents. This method operationalises camouflaging as the discrepancy between internal autistic characteristics (autistic traits/mentalising ability) and external autistic characteristics (ADOS score). Previous research using these methods found greater discrepancy scores for females than males (Lai et al., 2017, 2018); this study will attempt to replicate these findings in adolescents. The feasibility of using a self-report measure with autistic adolescents, who may have reduced insight into their own behaviours or ability to articulate this compared to adults, is examined by comparing the self-report CAT-Q completed by adolescents, and an informant-report CAT-Q completed by their parents, with the Camouflaging Discrepancy. If both are well-correlated with this objective measure of camouflaging, it would suggest that camouflaging behaviours can also be identified in younger individuals or those unable to report their own behaviours, through use of a parent-report measure. Clinical and research work in the future will likely benefit from combining multiple methods of measuring camouflaging, therefore it is important to compare these methods to determine the extent to which they are measuring the same underlying construct.

Additionally, recent research suggests that non-autistic individuals generally form negative first impressions of autistic people (Sasson et al., 2017), especially when their autism is not disclosed (Sasson & Morrison, 2017). Empirical reports of stigma, bullying, and isolation suggest that autistic people (whether or not they disclose their autism) often face discrimination and attacks when interacting with non-autistic others in social situations (Cage, Di Monaco, & Newell, 2017; Campbell et al., 2017; Weiss & Fardella,

2018). Avoiding these negative experiences was reported as a key motivation for camouflaging in Chapter 3, along with fitting in with others and forming good initial impressions which may lead to sustained social relationships. The CAT-Q is a measure of intention to camouflage, and therefore another way to evaluate the convergent validity of this measure is to examine its relationship with an intended outcome of camouflaging. This study therefore seeks to examine the success of camouflaging by identifying the relationship between multiple measures of camouflaging, and the extent of positive impression formed by others when an autistic adolescent is camouflaging. If greater CAT-Q score is associated with a more positive social impression, this would suggest that the individual's camouflaging strategies are relatively successful, and therefore that the CAT-Q measures some aspects of camouflaging success as well as intention.

There are likely to be many factors contributing to individual variation in camouflaging intention and success (Livingston & Happé, 2017). Some hypothesised cognitive mechanisms underlying camouflaging will be examined in Chapter 7. However, it is likely that these abilities, and therefore the ability to camouflage, may change as a young person develops and are also affected by overall intellectual ability. This study will take into account individual differences in age and IQ when examining the relationship between different measures of camouflaging and their success.

This thesis seeks to examine camouflaging in the context of the female autism phenotype. In Chapter 5, it was demonstrated that autistic women report greater camouflaging than autistic men; however there has been limited research into gender differences in younger ages. It was also suggested in Chapter 4 that there may be gender differences in the success of camouflaging as well as intention to camouflage; some respondents suggested that autistic men use similar strategies to women but do not feel they achieve the desired results. It is therefore also important to explore whether the relationship between camouflaging and positive impressions (i.e. the success of camouflaging) differs for adolescent males and females.

### 6.2.1 Research Questions

1. Testing concurrent validity of the CAT-Q: what is the relationship between different measures of camouflaging (self-report, parent-report, and discrepancy), and social difficulties, for autistic adolescents?
2. Testing convergent validity of the CAT-Q: How well do different measures of camouflaging (self-report, parent-report, and discrepancy) and social difficulties predict success of camouflaging (positive impression formation) in autistic adolescents, while controlling for age and IQ?
3. Does the relationship between camouflaging intention (self-report or parent-report) and success of camouflaging vary across genders, while controlling for age and IQ?

## 6.3 Methods

### 6.3.1 Participants

#### 6.3.1.1 A priori power analysis

Research Question 1: Based on previous measure validation work on a parent-report questionnaire amongst autistic children, moderate-to-large correlations are expected between measures of theoretically related traits (Strang et al., 2017). Power analysis determined that a sample size of 46 would be necessary to detect large, two-tailed correlations ( $r = 0.40$ ) with power = 0.80 between two measures of camouflaging.

Research Questions 2&3: Previous research into multiple predictors of the social outcomes of autistic adults suggests that large effect sizes will be found (Howlin et al., 2000). Power analysis determined that a sample size of 40 would be necessary to detect large effect sizes ( $f^2 = 0.35$ ) with power = 0.80 for the overall significance of a linear multiple regression with four predictors (three measures of camouflaging and one of social difficulties) of social impressions. In order to conduct balanced gender difference comparisons, a target sample of 40 male and 40 female autistic adolescents (total sample 80) was identified.

### 6.3.1.2 Final participants

Participants were recruited from NHS trusts (Great Ormond Street Hospital NHS Trust and Whittington Health NHS Trust), and through social media and word of mouth from across the UK. A total of 40 participants aged 13-18 were recruited at the time of the current analyses; characteristics of participants are detailed in Table 6.1. Within the total sample, 26 participants completed all measures and were included in the multiple regression analyses. Data collection is ongoing and these analyses will be replicated once the target sample is achieved.

### 6.3.1.3 Ethical Approval

Ethical approval for this study was obtained from the Health Research Authority and the Bloomsbury Research Ethics Committee (Reference 17/LO/2055).

## 6.3.2 Measures

### 6.3.2.1 Autistic participant measures

Autism Diagnostic Observation Schedule, Version 2 (ADOS-2; Lord et al., 2012)

A gold-standard semi-structured behavioural assessment tool for autistic characteristics. ADOS-2 comprises five modules depending on the individual's developmental and language abilities. Modules 3 and 4 (aimed at verbally fluent adolescents and adults) were used for all participants in this study. Symptom codes are scored on the ADOS for a range of behaviours observed across the entirety of the assessment. A standardised Calibrated Severity Score (CSS) was calculated for each participant based on the most up-to-date algorithms (Hus & Lord, 2014; Lord et al., 2012), with cut-off scores of 4 or above indicating clinically significant characteristics associated with an autism spectrum disorder.

The researchers collecting data for this study (the author and three clinical psychology trainees) were trained to research standards by a qualified ADOS trainer prior to data collection. Regular reliability and coding meetings were conducted within the research

group to ensure reliability of ADOS administration and coding, with consensus coding used for cases in which the individual researcher was uncertain.

#### Autism Quotient (Baron-Cohen et al., 2001)

A standardised self-report measure of autistic traits comprised of 50 items, suitable for clinical and subclinical populations. The AQ has demonstrated acceptable test-retest reliability and inter-rater reliability (Baron-Cohen et al., 2001). A score of 32 or above indicates clinically significant levels of autistic traits. Internal consistency in the current sample was acceptable ( $\alpha = .87$ ).

#### Camouflaging Autistic Traits Questionnaire

This is a 25 item self-report measure of camouflaging strategies. As described in Chapter 4, it has demonstrated good test-retest reliability and measurement invariance in autistic and non-autistic adults. Internal consistency in the current sample was good ( $\alpha = .92$ ).

#### Camouflaging Autistic Traits Questionnaire – Parent-Report

This is a 25-item adaptation of the CAT-Q, with phrasing changed from “I...” to “My child...” for each item; no other changes were made to the original wording or structure. Internal consistency in the current sample was good ( $\alpha = .91$ ). See Appendix 6.

#### Social Impressions Task

As there are no established behavioural measures of camouflaging, this newly developed behavioural task was designed to elicit camouflaging behaviours in a semi-natural environment. Participants were video recorded speaking directly to the camera about a holiday they had been on, or were planning to go on, for approximately one minute, and were allowed to spend approximately 30 seconds thinking about what they wanted to say before recording started. Before speaking, participants were asked to “make a good impression for the camera” and “to be your best social self” (see Appendix 7 for detailed procedure). This behavioural task was evaluated by student raters to produce an overall social impression score, as described in more detail below.

Social Reciprocity Scale (SRS; Constantino & Gruber, 2007)

A standardised parent-report measure of a child's social abilities, comprised of 65 items. Acceptable levels of reliability and validity have been found in a general population sample of British children (Wigham, McConachie, Tandos, & Le Couteur, 2012). A standardised T-score is calculated for each child, with a mean of 50 and standard deviation of 10. Total scores of 60 and above are indicative of clinically significant social difficulties associated with autism. The Social Cognition Index (SCI; comprised of 53 items) was used as a proxy of social difficulties in these analyses, with higher scores representing greater social difficulty.

Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II; Wechsler, 2011)

The WASI-II is a standardised measure of intellectual ability suitable for children and adults aged 6-90 years. The WASI-II has demonstrated good-to-excellent internal consistency in both child and adult populations (McCrimmon & Smith, 2013). Fullscale IQ scores were calculated for each participant in the current analyses.

#### 6.3.2.2 Student rater measures

Social Impression questionnaire (adapted from Sasson et al., 2017; Study 1)

This is a 10-item measure of the social impression formed of the person in a video being watched. Raters are asked to give their anonymous impression of the person on a range of six traits (e.g. likeability, awkwardness), and four behavioural intentions (e.g. willing to sit next to them). One item was changed from the original measure used by Sasson and colleagues (2017); due to the age difference between adolescent participants and student raters, item 1 was changed from "I think the person is attractive" to "I think the person is engaging". See Appendix 8.

#### 6.3.3 Procedure

Assessments took place at participants' home or school, or at private testing rooms in UCL. All measures were administered by trained UCL doctoral students (PhD and

DClinPsych), and participants were referred to by numerical pseudonyms on all paper and electronic copies of measures. Adolescents completed the ADOS Module 4 (unless they had completed an ADOS Module 3 or 4 within the previous 12 months at their local clinic, and the family had given consent for this to be accessed), which was video recorded, in a private room, and completed the Social Impressions task, which was also video recorded. This took approximately 40 minutes, after which a 20-minute break was given unless the participant requested continuing with the study sooner. Adolescents then completed the WASI (unless a WASI or WISC-IV measure of IQ had already been recorded in the participant's medical notes, and the family had given consent for this to be accessed), and the CAT-Q and AQ. Parents completed the parent-report CAT-Q and SRS. The total study, with additional measures not included in the current analyses, took between 1.5 hours and 3 hours on average, depending on the number of assessments required and the number of breaks requested by the participant.

#### 6.3.3.1 Camouflaging Discrepancy score

In an adaptation from Lai et al. (2017), Camouflaging Discrepancy (CD) was calculated to produce a discrepancy score between internal autistic characteristics and external presentation for each participant. ADOS CSS and AQ scores were mean-centred to the whole sample ( $N = 40$ ) and scaled (divided by the maximum possible score of each), and CD score was calculated as standardised AQ score minus standardised ADOS score, following the procedure outlined by Lai et al. (2017). Higher CD scores represent greater camouflaging. Due to time constraints of the assessment process, only one proxy of internal autistic status was used in this study.

#### 6.3.3.2 Social Impressions ratings

Social Impression videos were edited to remove any personal information about the participant, or any reference to autism, and to remove any questions asked by the experimenter or pauses in speech. Edits were made so that each participant told a complete story or anecdote about their holiday which could be followed by the rater. All videos included the upper torso and face of the participant, so that any hand gestures

used would be visible. All autistic participants and parents consented to their videos being used in this way for research purposes. Videos ranged from 27 seconds to 1 minute and 7 seconds in length, with an average length of 57.79 seconds. Mean video length did not differ between male and female participants ( $t = 0.70, p = .49$ ).

42 students at University College London (20 female; mean age 20.34 years, range 18-28) were recruited to take part in a study of 'Social Impressions', which took place in private testing rooms at UCL. Students (referred to as raters for the remainder of this chapter) received credits as part of course requirements for taking part. Raters were told that they were taking part in a study of social impressions, and that they would be shown videos of young people talking about a holiday they had been on, and would be asked to rate their first impression of each person. No mention of autism was made before the raters watched any video. Each rater was shown eight randomly assigned videos, which were presented in a randomised order. Raters watched each video and then completed the SI questionnaire for the individual in that video, before watching the next video. Raters then completed a brief demographic questionnaire, were debriefed, and any questions were answered. All responses were anonymous.

Mean ratings from all raters were summed to give each participant a 'Total SI score', which was used as the dependent variable in the regression analyses. The number of total raters for each video varied between participant but ranged from 10 to 14 raters. Internal consistency of the total Social Impressions score was good in the total sample ( $\alpha = .93$ ).

#### 6.3.4 Statistical analyses

All analyses were performed in R (R Core Team, 2013) and SPSS version 23 (IBM Corp., 2015).

Research Question 1: A correlation matrix (Table 6.2) was used to examine relationships between self-reported and parent-report camouflaging, Camouflaging Discrepancy (CD), parent-reported social difficulties, and social impression.



Research Question 2: A multiple regression analysis was used to identify which measure(s) of camouflaging (self-report and parent-report CAT-Q, and Camouflaging Discrepancy) best predict total social impression score. Age and IQ were included as covariates.

Research Question 3: Separate multiple regressions were run for male and female participants, to identify the individual relationships between camouflaging intention (self-report and parent-report CAT-Q), Camouflaging Discrepancy, and success (total social impressions score). Age and IQ were included as covariates. Although correcting for multiple comparisons would reduce the risk of Type ii errors, uncorrected analyses are reported as these samples were already underpowered to detect the predicted relationships. Significant findings at  $p < .05$  are interpreted with great caution, and as merely suggestive of relationships which should be replicated with corrected analyses in larger samples.

#### 6.4 Results

Mean scores for all participants, and broken down by gender, are reported in Table 6.1. Females had significantly higher levels of parent-rated social difficulties, camouflaging discrepancy, self-reported camouflaging, and self-reported autistic traits than males. Males and females did not differ on any other variable.

Table 6.1. Means and gender differences on all variables

	Range	Total Sample	Male Subsample	Female Subsample	Difference	Effect size (d)
N		40	19	21		
Age (years)	13-18	14.33 (1.39)	14.26 (1.45)	14.38 (1.36)	F(1,39) = 0.07, p = .79	0.09
FSIQ	70-160	104.46 (14.37)	106.00 (15.58)	103.15 (13.53)	F(1,36) = 0.36,	0.20

	Range	Total Sample	Male Subsample	Female Subsample	Difference	Effect size (d)
					p = .56	
Self-Report CAT-Q	25-175	105.59 (26.37)	95.78 (21.43)	113.99 (26.37)	F(1,38) = 5.13, p = .029	0.75
Parent-Report CAT-Q	25-175	109.89 (26.74)	105.39 (29.78)	114.85 (23.32)	F(1,37) = 1.47, p = .23	0.36
ADOS CSS	0-10	5.52 (2.77)	5.89 (2.81)	5.15 (2.76)	F(1,38) = 0.70, p = .41	0.27
Autism Quotient	0-50	25.35 (8.52)	21.44 (8.18)	28.33 (7.67)	F(1,36) = 6.49, p = .013	0.87
Camouflaging Discrepancy	NA	-0.01 (0.30)	-0.12 (0.30)	0.09 (0.28)	F(1,35) = 4.62, p = .039	0.73
SRS SCI	0-100	79.58 (8468)	75.42 (8.93)	83.33 (6.61)	F(1,39) = 10.28, p = .003	1.02
Social Impression	0-30	16.16 (4.36)	16.51 (3.81)	15.83 (4.92)	F(1,25) = 0.24, p = .63	0.15

CAT-Q = Camouflaging Autistic Traits Questionnaire; ADOS CSS = ADOS Calibrated Severity Score SRS SCI = Social Responsiveness Scale, Social Cognition Index

Correlations between all variables of interest are reported in Table 6.2. In examination of Research Question 1, self-reported and parent-report CAT-Q scores were found to be strongly positively correlated ( $r = 0.58$ ,  $p = .0001$ ). Self-report CAT-Q scores were moderately positively correlated with Camouflaging Discrepancy ( $r = 0.36$ ,  $p = .031$ ). Parent-report CAT-Q scores were moderately positively correlated with Camouflaging Discrepancy ( $r = 0.47$ ,  $p = .004$ ). No measure of camouflaging was significantly correlated with social difficulties or social impression, although the relationship between parent-report CAT-Q and social impression approached significance ( $r = 0.35$ ,  $p = .08$ ).

Table 6.2. Correlations between measures of camouflaging, social difficulties, and social impression (N = 40).

	Self-Report CAT- Q [95% CI]	Parent-Report CAT-Q [95% CI]	Camouflaging Discrepancy [95% CI]	SRS SCI [95% CI]
Parent-Report CAT-Q	0.58*** [0.31, 0.76]			
Camouflaging Discrepancy	0.36* [0.03, 0.62]	0.47** [0.16, 0.69]		
SRS SCI	0.12 [-0.20, 0.42]	-0.06 [-0.38, 0.26]	0.08 [-0.25, 0.40]	
Social Impression	-0.13 [-0.49, 0.27]	0.35 [-0.04, 0.65]	0.29 [-0.11, 0.61]	-0.12 [-0.49, 0.28]

\* =  $p < .05$ , \*\* =  $p < .01$ , \*\*\* =  $p < .001$ . CAT-Q = Camouflaging Autistic Traits Questionnaire; SRS SCI = Social Responsiveness Scale, Social Cognition Index

To further explore the predictive relationship between camouflaging and social impression, and to control for age and IQ, a multiple regression with age, IQ, self-report CAT-Q, parent-report CAT-Q and CD as predictors of social impression score was run. The results are displayed in Table 6.3. The total model was marginally significant ( $F[5,20]$

= 2.66,  $p = .05$ , Adj  $R^2 = 0.25$ ). In examination of Research Question 2, parent-report CAT-Q was a significant predictor of social impression ( $\beta = 0.61$ ,  $p = .01$ ). Neither self-report CAT-Q nor CD significantly predicted total social impression score. Residuals were examined and no substantial deviations from normality were observed. Assumptions of independence of errors and multicollinearity were met.

Table 6.3. Predictors of Social Impression Score in the total sample. Significant predictors are in bold.

	B	$\beta$	p	95% CI
Intercept	-9.00		0.46	-34.10 – 16.10
<b>Age</b>	<b>1.36</b>	<b>0.42</b>	<b>0.03</b>	<b>0.02 – 2.69</b>
IQ	-0.01	-0.02	0.92	-0.14 – 0.12
Self-report CAT-Q	-0.06	-0.33	0.11	-0.13 – 0.02
<b>Parent-report CAT-Q</b>	<b>0.12</b>	<b>0.61</b>	<b>0.02</b>	<b>0.03 – 0.21</b>
CD	0.93	0.06	0.77	-5.71 – 7.58

95% CI = 95% Confidence Intervals; CAT-Q = Camouflaging Autistic Traits Questionnaire; CD = Camouflaging Discrepancy.

As a follow-up exploratory analysis of potential gender differences, separate multiple regressions were run in the male and female subsamples. Samples were not large enough to examine the moderating effects of gender at this stage, therefore results are presented as preliminary explorations. Each regression examined the relationship between self-report CAT-Q, parent-report CAT-Q, CD, and social impression while controlling for age and IQ. The assumption of normality of variance across genders was met. Results are reported in Table 6.4; the total model for females was not significant ( $F[4,10] = 2.44$ ,  $p = .11$ , Adj  $R^2 = 0.29$ ), while the total model for males trended towards

significance ( $F[4,8] = 3.68, p = .06, \text{Adj } R^2 = 0.47$ ). We found that parent-report CAT-Q was a significant predictor of social impressions scores for female participants ( $\beta = 0.82, p = 0.02$ ), but not for males ( $\beta = 0.43, p = 0.12$ ); no other variables were significant predictors in either sample.

Table 6.4 Predictors of Social Impression Score in Female and Male Samples. Significant predictors are in bold.

Female Sample

$R^2\text{Adj} = 0.29, F(4, 10) = 2.44, p = .11$

	B	$\beta$	p	95% CI
Intercept	-11.53		0.47	-45.51 – 22.45
Age	1.95	0.52	0.07	-0.14 – 4.04
IQ	-0.14	-0.40	0.19	-0.35 - 0.08
Self-report CAT-Q	-0.05	-0.30	0.24	-0.15 – 0.04
<b>Parent-report CAT-Q</b>	<b>0.18</b>	<b>0.82</b>	<b>0.02</b>	<b>0.04 – 0.33</b>

Male Sample

$R^2\text{Adj} = 0.47, F(4, 8) = 3.68, p = .06$

	B	$\beta$	p	95% CI
Intercept	-19.14		0.10	-42.51 – 4.22
Age	1.29	0.50	0.06	-0.07 – 2.64
IQ	0.10	0.39	0.12	-0.03 – 0.23
Self-report CAT-Q	-0.01	-0.07	0.78	-0.11 – 0.08
Parent-report CAT-Q	0.08	0.43	0.12	-0.02 – 0.16

95% CI = 95% Confidence Intervals; CAT-Q = Camouflaging Autistic Traits Questionnaire

## 6.5 Discussion

### 6.5.1 Discussion of findings

This study compared multiple measures of camouflaging (self- and parent-reported reflective/observational and discrepancy methods) and their relationship with the impression formed when an adolescent presents their best social self.

#### 6.5.1.1 Research Question 1

The first research question aimed to test convergent validity of the CAT-Q when used with autistic adolescents by identifying the relationships between self- and parent-reported CAT-Q scores, the Camouflaging Discrepancy (CD) measure of camouflaging, and parent-reported social difficulties.

Good internal consistency was found for both self-report and parent-report CAT-Q. A large positive correlation was found between self-report and parent-report CAT-Q scores, suggesting that adolescents and their parents have relatively similar perceptions of the adolescent's camouflaging strategies. Both self- and parent-reported camouflaging were moderately positively correlated with CD score. This provides further convergent validity for the CAT-Q as a measure of camouflaging, since the CD is another established and reliable discrepancy-based measure of camouflaging (Lai et al., 2017; 2018). In addition, this finding suggests that the parent-report CAT-Q can be used as a measure of camouflaging when individuals are unable to identify or report their camouflaging strategies themselves. The parent-report CAT-Q could potentially be used with younger autistic children, and with those with intellectual disability or language impairments, to explore potential camouflaging in these groups, although this requires further testing.

However, a parent-report measure risks some of the same issues of discrepancy approaches to measuring camouflaging; that unsuccessful strategies, or those which do not produce observable behavioural changes, will not be identified. Future work should evaluate the practicality of using the CAT-Q with autistic adolescents in a larger sample

and across a broader age range, and should aim to develop age- and ability-appropriate versions of the CAT-Q for use with a broader range of the autistic population. One way to do this may be to adapt the phrasing of specific CAT-Q items, working with focus groups of autistic and non-autistic children and young people, and use factor analysis to test the similarities in underlying structure with the original self-report CAT-Q.

No measure of camouflaging included in these analyses was significantly correlated with social difficulties, as measured by the Social Cognition Index of the SRS. This offers discriminant validity both for the CAT-Q and for the construct of camouflaging itself; supporting the idea that camouflaging does not simply represent greater social skills being expressed behaviourally, but a distinct process of masking and compensating for autistic social difficulties and other characteristics.

#### 6.5.1.2 Research Question 2

The second research question sought to identify the relationship between these self-report and discrepancy measures of camouflaging and the social impression formed while an individual is camouflaging. This aimed to test the convergent validity of the CAT-Q by comparing reported camouflaging strategies with camouflaging success.

In a multiple regression model, greater parent-reported camouflaging predicted a more positive social impression being formed. This offers further convergent validity for the CAT-Q as a measure of camouflaging; the more a young person attempts to camouflage their autistic characteristics, the more positively they are perceived by others who do not know they are autistic. A previous study using a related and similar method of social impression estimation (Sasson et al., 2017) found that more negative impressions were formed of autistic individuals than non-autistic individuals. As described in Chapter 3, avoiding these negative impressions and the resulting discrimination is a key motivation for camouflaging. This finding demonstrates that although the CAT-Q is a measure of camouflaging intentions, it also predicts camouflaging success.

The only other significant predictor in this model was age; older adolescents made more positive social impressions. This may be because older adolescents have had more time to develop and practice their camouflaging strategies, and so use more effective strategies which produce a more positive impression. Self-reported camouflaging appeared to predict poorer social impressions, although this association was not significant. This is somewhat surprising, but may reflect the difficulties of identifying camouflaging strategies (or the success of camouflaging strategies) experienced by adolescents. Autistic adolescents may identify and report camouflaging strategies which require more effort from them, even if they are less successful, whereas their parents may identify strategies which they see as being successful.

Interestingly, Camouflaging Discrepancy (CD) was not a significant predictor of social impression. CD is the discrepancy between the clinical assessment of behavioural expression of autism (ADOS CSS score), and self-reported autistic characteristics (AQ score). It is possible that the young people in this study had similar difficulties self-reporting their autistic characteristics as they did their camouflaging strategies, leading to inaccurate CD scores. However, CD was positively correlated with self- and parent-report CAT-Q, suggesting it is a valid measure of camouflaging in this sample. It may be that CD reflects clinical impressions of autism (as the ADOS score is calculated by professionals trained in identifying autistic characteristics), whereas the social impressions score calculated in this study reflects the first impressions of lay individuals with limited experience or recognition of autism. Another possible explanation is that the study was underpowered to detect the smaller predictive effect of CD than of parent-report CAT-Q, as our target sample was barely met. This question should be re-examined in a sample large enough to detect smaller relationships; although the small size of the correlation coefficient compared to that of parent-report CAT-Q suggest this may not solve the issue.



### 6.5.1.3 Research Question 3

The final research question was a preliminary exploration of the relationship between measures of camouflaging and social impression in males and females separately. These analyses were underpowered to detect the predicted effects, therefore non-significant results are interpreted with caution as the lack of significant finding, rather than evidence for no relationship, to take into account the increased risk of Type I errors.

Girls' self-reported CAT-Q scores were higher than boys', supporting the self-reported gender differences observed in Chapter 5. However, no significant gender difference in parent-reported CAT-Q scores was found. This sample may have been too small to detect the smaller gender differences reported by parents; the difference between male and female parent-reported CAT-Q scores was of a small size, suggesting that with a larger sample significant differences may be observed. Alternatively, parents may be reporting on different types of camouflaging behaviours, which may occur at similar levels in girls and boys. This will be explored in greater detail in Chapter 7, where gender differences in CAT-Q subscales are presented. Previous research in adolescents has shown either greater camouflaging in girls (Dean et al., 2017) or a trend towards greater female camouflaging (Rynkiewicz et al., 2016).

Girls in this sample had higher AQ scores on average, and higher levels of social difficulties, than boys, even with comparable IQ and ADOS CSS scores. This supports previous arguments that autistic females may need greater severity of characteristics in order to receive a diagnosis compared to males (Duvekot et al., 2016; Shattuck et al., 2009). Another explanation could be that girls in this sample are better at introspection, and so self-reported and/or expressed to their parents more autistic characteristics than boys.

A large, significant gender difference in Camouflaging Discrepancy (CD) was observed, with girls having a greater discrepancy between internal autistic traits and external behavioural presentation, in replication of the findings of Lai and colleagues (2017) in

adults. This is likely to have been driven by the significantly higher AQ scores for girls compared to boys; in other words, girls may report more autistic characteristics than boys even if both appear to have a similar clinical presentation. There was no gender difference in ADOS calibrated severity score or the overall social impression score for this sample. This is interesting, as it suggests that although autistic girls may experience more difficulties related to autism than boys, this is not necessarily picked up during clinical assessments or by lay people with minimal knowledge of autism. Regardless of their level of expertise in autism, the gatekeepers of access to support and diagnosis (such as GPs, psychiatrists, psychologists, or teachers), may not identify the autistic characteristics experienced by girls and reported by their parents, reducing the likelihood of on-time, accurate diagnosis (Kirkovski et al., 2013; Kreiser & White, 2014).

When examined separately, parent-reported CAT-Q was found to predict social impression in females but not in males. The number of complete responses from males was very small, however, and therefore this analysis was likely underpowered to detect any relationships which do exist. Despite this, the predictive effect of parent-reported CAT-Q on social impression was almost twice the size for girls ( $\beta = 0.82$ ) than for boys ( $\beta = 0.43$ ). This suggests that girls' camouflaging abilities may have greater impact on the impressions others form of them; in other words, girls may be more successful at achieving the aims of camouflaging than boys are. These preliminary findings support the observations of some participants described in Chapter 4; that males may be less successful in camouflaging, meaning their autistic characteristics are more visible during clinical assessments than females'. However, replication in an adequately powered sample is needed to strengthen this conclusion; males may be equally successful as females, or there may be other factors which influence the success of males' camouflaging which were not measured here.

These analyses controlled for both age and IQ, therefore it is not simply the case that girls in our sample were more intellectually able than boys; as previous research has demonstrated that greater intelligence is associated with more positive perceptions of

others (Murphy, 2007). Although older individuals may be more successful at camouflaging (as they produced more positive social impressions), girls and boys were matched on age, and age was included as a covariate in each regression. However, as no measure of social skills intervention was included in this study, we cannot be certain that social impression scores reflect camouflaging behaviours developed by the individual on their own. Adolescents who received more (or any) interventions targeting social skills may use those skills when asked to 'make a good impression', rather than using camouflaging strategies with the implicit aim of minimising autistic characteristics. It is important that future research identifies the similarities and differences between camouflaging strategies developed or learned by the individual themselves, and skills explicitly taught to them.

Greater success at camouflaging, and greater camouflaging intention, may explain the role of camouflaging in the female phenotype. Autistic males and females may experience similar expectation to camouflage (as reported in Chapter 5), and as adolescents may use similar levels of more observable camouflaging strategies. If, however, autistic girls are more successful with these camouflaging attempts, they are less likely to be identified in classrooms or clinical settings, and less likely to meet behavioural diagnostic thresholds. Greater success of camouflaging may reduce the likelihood of diagnosis in females.

An implication of this finding is that both intention and success of camouflaging should be taken into account during the autism diagnostic process. Autistic males may report high levels of camouflaging, but also score highly enough on diagnostic tools to meet diagnostic criteria. Autistic females, in contrast, may also report high levels of camouflaging but may not meet behavioural diagnostic criteria. It may be worth considering lowering diagnostic thresholds for females who report high levels of camouflaging, as their behavioural presentation may represent more successful camouflaging than that of males. As described in Chapter 4, camouflaging is associated

with negative mental health outcomes, therefore all genders' camouflaging should be assessed and considered in the context of their broader wellbeing.

There were several limitations of this study. Firstly, these analyses involved undergraduate student raters evaluating adolescent participants. Raters may have evaluated participants based on social norms for individuals their own age (i.e. adults), rather than according to age-appropriate social expectations. Due to time constraints, this study was not able to recruit a sample of age- and gender-matched peers to rate social impressions. This is an important future step to determine the social impressions that autistic adolescents make on their peers when they camouflage, which may have the most impact on their social relationships and sense of self.

Secondly, the behavioural camouflaging task used in this study was experimental and has not been independently validated. There was no explicit measure of how much the participants were actually camouflaging when they were asked to talk about their holiday. This design could be improved by piloting and directly examining which camouflaging strategies participants use while talking about their holiday. This would also allow for further examination of the degree to which autistic adolescents are aware of the camouflaging behaviours they use in real life, as opposed to those they report in the CAT-Q.

#### 6.5.2 Conclusions and Next Steps

This chapter suggests both self- and parent-report CAT-Q can be used to measure camouflaging in adolescence, as both are well correlated with another established measure of camouflaging. The parent-report CAT-Q additionally predicts camouflaging success (as measured by positive social impression when camouflaging), and may do so to a greater extent than other measures of camouflaging.

There was some preliminary evidence to suggest that females may be more successful in their camouflaging strategies than males, as a significant relationship between parent-reported camouflaging and social impression was found for females but not males. This

has implications for the female phenotype of autism, as this relationship may account for the underdiagnosis of autism in females.

Future research needs to replicate these findings in a larger sample, in order to determine whether non-significant results are due to the study being underpowered. As there was no correction for multiple comparisons, it is also important to replicate these analyses in an adequately sized sample, to determine whether significant findings were the result of Type I error. To understand why camouflaging strategies are successful for some individuals and not for others, the mechanisms involved in camouflaging should be explored. Chapter 7 explores hypothesised cognitive predictors of self- and parent-camouflaging in the same adolescent sample.

## **CHAPTER 7: COGNITIVE PREDICTORS OF CAMOUFLAGING IN AUTISTIC ADOLESCENTS (STUDY 6)**

### **7.1 Abstract**

Individual variation in autistic adults' self-reported camouflaging, and autistic adolescents' camouflaging success, have previously been reported, including across genders. To understand how some of these individual differences may emerge, potential cognitive mechanisms involved in camouflaging should be examined. This study examined the role of five such predictors (age, IQ, executive function, theory of mind, and social motivation) of self-reported and parent-reported camouflaging in autistic adolescents. Supplementary analyses also explored the relationship between these predictors and camouflaging in males and females separately, to identify potentially gender-specific mechanisms. Better executive function and lower social motivation predicted greater camouflaging in the total sample. These findings suggest individual variation in cognitive abilities may affect the psychological demand of camouflaging as well as account for gender differences in camouflaging success. However, replication of these analyses in a larger sample are needed to confirm these preliminary results.

### **7.2 Introduction**

So far, this thesis has investigated how camouflaging of autistic traits can be conceptualised, operationalized and measured. Camouflaging involves the components of compensation, masking, and assimilation, which can be measured through the self-report Camouflaging Autistic Traits Questionnaire (CAT-Q). Camouflaging has many negative outcomes, as reported by participants in Chapter 3, but may also produce benefits for some individuals. As demonstrated in Chapter 6, the CAT-Q can be used to measure self-reported camouflaging in autistic teenagers, and both self- and parent-report versions have good concurrent validity. Chapter 6 also demonstrated that parent-reported camouflaging is related to positive social impressions while camouflaging,

suggesting that the CAT-Q measures successful camouflaging as well as camouflaging intention.

To understand more about the relationship between camouflaging intention and longer-term outcomes, it is important to examine the mechanisms underlying camouflaging. Specifically, are there cognitive abilities which may promote camouflaging? As yet there has been very limited research identifying specific mechanisms related to camouflaging, but some cognitive mechanisms have been proposed, and some of these have been empirically tested, although no research has yet examined cognitive mechanisms for self-reported camouflaging in autistic adolescents. Camouflaging has been operationalised in Chapter 4 as having three component factors; compensation (using strategies to overcome autism-related difficulties), masking (using strategies to hide autistic characteristics or present non-autistic characteristics), and assimilation (using strategies to fit in with others artificially). While overall camouflaging ability is likely to be influenced by more global cognitive processes, specific cognitive abilities may affect an individual's use of compensation, masking, or assimilation strategies.

Although the focus of this chapter will be on mechanisms underlying camouflaging more broadly, it is also important to consider whether these mechanisms vary across genders. A relationship between camouflaging intention and success was observed for females but not males in Chapter 6; it may be that different cognitive mechanisms are involved in producing these different outcomes. Gender differences in broader levels of these predictors will be discussed as this may determine how much they influence camouflaging.

## 7.2.1 Hypothesised cognitive predictors

### 7.2.1.1 IQ

Intellectual ability has been proposed as an important contributor to the ability to camouflage or compensate for autistic characteristics (Lehnhardt et al., 2015; Livingston & Happé, 2017). In particular, greater IQ was proposed to be a requirement for 'shallow'

compensation or behavioural masking of autistic characteristics, although not necessarily sufficient for 'deep' compensation (Livingston & Happé, 2017).

Greater intellectual ability is generally associated with more positive outcomes, including a reduction in observable autistic characteristics which may represent the development of successful camouflaging strategies (Black, Wallace, Sokoloff, & Kenworthy, 2009). IQ was found to differentiate compensation ability in a study of adolescents (Livingston et al., 2018), with high compensators having higher verbal and full-scale IQ than low compensators. However, another study did not find a relationship between verbal IQ and camouflaging ability (Lai et al., 2017). If IQ does contribute to camouflaging in autistic teens, it may represent a general ability rather than being related to a specific component of camouflaging. As described in Chapter 2, IQ does not appear to differ significantly between autistic males and females, and the patterns of gender difference are equivalent for autistic and non-autistic groups. IQ may therefore contribute to camouflaging in both males and females.

#### 7.2.1.2 Executive Function

In addition to IQ, executive function abilities have been most commonly associated with camouflaging in previous literature. High-level cognitive control, enabling flexibility of responses across situations, self-monitoring and inhibition of automatic behaviours, and the planning of appropriate responses, has been proposed to enable the subtle control of behaviours which underly camouflaging (Lehnhardt et al., 2015; Livingston & Happé, 2017). There is some evidence for the association between gender, camouflaging, and executive function. Lai and colleagues (2017) found an association between executive function and camouflaging in autistic women but not men, as well as evidence for an underlying neural mechanism, with greater cerebellum grey matter (associated with executive function abilities) correlated with greater camouflaging in females only. In a mostly male sample, high compensators were found to have greater executive function abilities than low compensators, suggesting that this relationship might not be limited to females (Livingston et al., 2018). Some level of executive function ability may be



necessary for general camouflaging abilities, and may be especially important for the compensation and masking components of camouflaging as these involve the deliberate use of learned strategies, and self-monitoring and inhibition of innate behaviours respectively.

As described in Chapter 2, the presence and direction of gender differences in autistic executive function abilities varies depending on the task used, but patterns between autistic and non-autistic groups do differ, suggesting that autistic females may have different executive function abilities compared to males (Demetriou et al., 2018). Executive functions may also play a role in the observed gender differences in camouflaging, with Lehnhardt and colleagues (2015) reporting higher executive function abilities in late diagnosed women but not men.

#### 7.2.1.3 Theory of Mind

Some researchers have also suggested that theory of mind or mentalising abilities may promote greater camouflaging. Camouflaging likely requires some level of understanding of what others expect from you (i.e. recognition of non-autistic social norms and expectations), and for a camouflaging attempt to be successful, an individual may need to identify how others perceive them and adapt their behaviours accordingly. Being aware of others' responses to camouflaging attempts is also necessary to improve camouflaging over a longer period of time. Livingston and Happé (2017) suggest that developing alternative neural routes to theory of mind may be a form of compensation which produces behaviours associated with camouflaging; it therefore stands to reason that greater theory of mind abilities (however developed) are likely to be associated with greater overall camouflaging.

No association between the temporal parietal junction (an area traditionally associated with mentalising/theory of mind) and camouflaging has been found for either males or females (Lai et al., 2018). This may reflect the use of alternative neural mechanisms as proposed by Livingston and Happé (2017); however no cognitive measure of theory of

mind was included in the study by Lai and colleagues, therefore it is unclear what participants' theory of mind abilities actually were. The only other study to empirically examine potential mechanisms of camouflaging (Livingston et al., 2018) used theory of mind ability as part of the measure of camouflaging (operationalised as the discrepancy between ADOS score and theory of mind), therefore the role of theory of mind itself as a mechanism for camouflaging could not be evaluated. No studies have yet examined cognitive theory of mind in relationship to a separate measure of camouflaging. We suggest that theory of mind may play a particular role in promoting masking and assimilation strategies, as these rely on understanding how others perceive you. The findings of Chapter 2 suggest autistic females may have greater theory of mind abilities than males, whereas typically developing females and males may not differ significantly; this therefore suggests that autistic females may use these abilities to camouflage more.

#### 7.2.1.4 Social Motivation

A final individual component which has been proposed, although not yet empirically tested, is social motivation. Greater social motivation (as measured by friendship quality and understanding) has been found in autistic girls than boys (Head et al., 2014), with researchers suggesting that this may enable autistic females to appear more superficially socially successful even if other social difficulties remain. Autistic individuals who are very invested in their friendships may be more motivated to adapt their behaviour to that of their peers, compared to individuals with reduced desire or intention to socialise. Autistic females' greater attention to and observation of others may also lead to greater imitation, and therefore the presentation of more socially acceptable behaviours (Kok, Groen, Becke, Fuermaier, & Tucha, 2016). Studies examined in Chapter 2 gave inconclusive results, but there was some evidence for lower social motivation in autistic males compared to autistic females or non-autistic individuals of either gender, suggesting again that these abilities may be especially useful for females' camouflaging. The role of social motivation in camouflaging, and potentially greater social motivation or expectation for females than males, was described by some participants in Chapter 3.

Previous qualitative work has also proposed that females may feel greater social expectations and so adapt their behaviours in response (Bargiela et al., 2016; Milner et al., 2019). However, no research has yet looked at social motivation in relation to empirical measures of camouflaging.

### 7.2.2 The present study

This study is the first to examine these proposed cognitive components in autistic adolescents, and in particular is the first to examine the roles of theory of mind and social motivation in relation to self- and parent-reported camouflaging and its component parts. Age is also included as a predictor, as older adolescents are likely to have had more time to develop and practice their camouflaging abilities. The main analyses will focus on autistic adolescents as a broad group; however follow-up exploratory analyses will examine the role of these components separately in females and males to explore the possibility of gender differences.

### Research Questions

Which cognitive and individual characteristics (executive function, theory of mind, social motivation, IQ, age) predict self-reported and parent-reported camouflaging total and subscale scores in autistic adolescents?

What are the relationships between cognitive/individual characteristics and camouflaging in males and females separately?

## 7.3 Methods

### 7.3.1 Participants

#### 7.3.1.1 A priori power analysis

As no studies have previously examined predictors of camouflaging amongst autistic individuals, reputation management was used as a proxy. Previous research suggests large correlations between friendship motivation and reputation management amongst typically developing children (Cage et al., 2016), although smaller effects can be

expected when more predictors are included. Power analysis determined that a total sample size of 92 would be necessary to detect medium effect sizes ( $f^2 = 0.15$ ), or a sample of 43 to detect large effects ( $f^2 = 0.35$ ), with power = 0.80 for the overall significance of a linear multiple regression with five predictors of social camouflaging.

#### 7.3.1.2 Final participants

Participants included in this study were the same as those described in Chapter 6. A total of 40 participants aged 13-18 (21 female) were recruited at the time of the current analyses. Participant characteristics are detailed in Table 7.1.

#### 7.3.1.3 Ethical approval

Ethical approval for this study was obtained from the Health Research Authority and the Bloomsbury Research Ethics Committee (Reference 17/LO/2055).

### 7.3.2 Measures

#### Camouflaging Autistic Traits Questionnaire

This is a 25 item self-report measure of camouflaging strategies. As described in Chapter 4, it has demonstrated good test-retest reliability and measurement invariance in autistic and non-autistic adults. Internal consistency for total self-reported CAT-Q score in the male ( $\alpha = .91$ ) and female ( $\alpha = .93$ ) samples was excellent.

#### Camouflaging Autistic Traits Questionnaire – Parent-Report

This is a 25-item adaptation of the CAT-Q, with phrasing changed from “I...” to “My child/they...” for each item (e.g. “My child always thinks about the impression they make on other people”); no other changes were made to the original wording or structure. Internal consistency for total parent-reported CAT-Q score in the male ( $\alpha = .91$ ) and female ( $\alpha = .93$ ) samples was excellent.

Behaviour Rating Inventory of Executive Function, Second Edition (BRIEF-2; Gioia, Isquith, Guy, & Kenworthy, 2015)

The BRIEF-2 is a 63 item informant-report measure of executive function difficulties, suitable for use with children aged 5-18 years. It consists of nine subscales reflecting different aspects of executive function abilities, and an overall score representing general executive function impairment. The parent-report version was used for this study, and total executive function difficulty scores (with higher scores indicating great executive function impairment) were included in analyses. Although this is not a direct test of executive function ability, the BRIEF demonstrates greater ecological validity than many other measures of executive function (Demetriou et al., 2018).

Strange Stories (adapted from Happé, 1994)

The Strange Stories task is a semi-naturalistic measure of theory of mind, which aims to measure participants' abilities to understand the mental states of others in the context of everyday situations described in short stories. Following previous studies from the original author (Happé, Brownell, & Winner, 1999; Happé, Winner, & Brownell, 1998), a subsample of sixteen stories were included in the battery for the present study, which take around ten minutes to complete. Eight 'social' stories testing theory of mind, and eight control stories of similar conceptual complexity, but without theory of mind components, were shown to participants, who were asked to read the story and then turn the page when they were finished. They were then asked a structured question designed to elicit understanding of underlying mental states (for the social stories) or understanding of the events that were described (for the control stories). Correct answers are awarded two points, partially correct answers one point, and incorrect answers no points according to the standardised scoring (Happé, 1994). For the current analyses, a total 'theory of mind' accuracy score was calculated from the sum of all scores for social stories, following previous procedures (Murray et al., 2017). Internal consistency for control stories was acceptable ( $\alpha = .80$ ), while internal consistency for social stories was poor in the total sample ( $\alpha = 0.52$ ).

Friendship Questionnaire (FQ; Baron-Cohen & Wheelwright, 2003)

A 35-item self-report questionnaire measuring friendship intentions, quality of friendships, and empathy. This questionnaire has been used in autistic and non-autistic samples (Baron-Cohen & Wheelwright, 2003), and a total score out of 135 is calculated, with higher scores representing greater social motivation. Internal consistency was acceptable in the total sample ( $\alpha = 0.74$ ).

Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II; Wechsler, 2011)

The WASI-II is a standardised measure of intellectual ability suitable for children and adults aged 6-90 years. The WASI-II has demonstrated good-to-excellent internal consistency in both child and adult populations (McCrimmon & Smith, 2013). Full-scale IQ scores were calculated for each participant in the current analyses.

### 7.3.3 Procedure

Measures were administered as part of the procedure described in Chapter 6. Adolescents completed the Friendship Questionnaire and Strange Stories after completing the other tasks previously described. Parents completed the BRIEF-2 concurrently with the other measures.

### 7.3.4 Analyses

All analyses were performed in R (R Core Team, 2013) and SPSS version 23 (IBM Corp., 2015).

Gender differences in all variables were calculated using MANOVA. Correlations between all variables were calculated for the total sample (Table 7.2).

Eight multiple regressions predicting either self- or parent-reported camouflaging were run (total CAT-Q and Compensation, Masking, and Assimilation subscales) in the total sample. Exploratory analyses were also performed separately in male and female samples, to predict self- and parent-reported total CAT-Q score from cognitive and individual variables. Again, as samples were already underpowered to detect medium or

large effect sizes, correction for multiple comparisons was not performed therefore results at  $p < .05$  are interpreted with caution due to increased risk of Type I errors.

#### 7.4 Results

Mean scores for all variables by gender are displayed in Table 7.1. Total self-report camouflaging, and self- and parent-reported assimilation scores were higher for females than for males. No other gender differences reached significance. Correlations between all variables are reported in Table 7.2.

Table 7.1. Means, standard deviations, and gender differences on all variables for males ( $n = 19$ ) and females ( $n = 21$ )

	Possible Range	Total Sample	Male Subsample	Female Subsample	Difference	Effect size (Cohen's d)
N		40	19	21		
Age (years)	13-18	14.33 (1.39)	14.26 (1.45)	14.38 (1.36)	F(1,39) = 0.07, p = .79	0.09
FSIQ	70-160	104.46 (14.37)	106.00 (15.58)	103.15 (13.53)	F(1,36) = 0.36, p = .56	0.20
BRIEF-2	30-90	72.05 (11.65)	71.00 (12.52)	73.10 (10.943)	F(1,39) = 0.32, p = .58	0.18
ToM	0-16	12.41 (2.40)	12.79 (2.35)	12.05 (2.40)	F(1,38) = 0.95, p = .34	0.31
FQ	0-135	67.86 (18.50)	67.27 (13.99)	68.14 (21.49)	F(1,35) = 0.02, p = .89	0.05

	Possible Range	Total Sample	Male Subsample	Female Subsample	Difference	Effect size (Cohen's d)
Self-Report CAT-Q	25-175	105.59 (26.37)	95.78 (21.43)	113.99 (26.37)	F(1,38) = 5.13, p = .029	0.75
Self-Report Comp	9-63	35.97 (13.33)	33.23 (12.39)	38.44 (13.96)	F(1,39) = 1.655 p = .22	0.39
Self-Report Mask	8-56	36.01 (10.84)	34.10 (7.98)	37.74 (11.36)	F(1,39) = 1.35, p = .25	0.37
Self-Report Assim	8-56	34.54 (10.84)	30.38 (10.27)	38.30 (10.154)	F(1,39) = 6.01, p = .019	0.78
Parent-Report CAT-Q	25-175	109.89 (26.74)	105.16 (29.14)	114.63 (23.94)	F(1,37) = 1.20, p = .28	0.40
Parent-Report Comp	9-63	39.80 (10.47)	38.22 (10.40)	41.26 (10.58)	F(1,38) = 0.82, p = .37	0.29
Parent-Report Mask	8-56	30.32 (10.13)	30.96 (9.98)	29.71 (10.50)	F(1,38) = 0.14, p = .71	0.12
Parent-Report Assim	8-56	36.96 (7.31)	34.48 (6.78)	39.31 (7.16)	F(1,38) = 4.56 p = .037	0.69

Note. BRIEF-2 = Behaviour Rating Inventory of Executive Function, 2<sup>nd</sup> Edition; ToM = Strange Stories test of Theory of Mind; FQ = Friendship Questionnaire; CAT-Q = Camouflaging Autistic Traits Questionnaire; Comp = Compensation subscale; Mask = Masking subscale; Assim = Assimilation subscale



Table 7.2. Correlations between all variables for total sample (N = 40). Significant correlations are in bold.

	Age	IQ	BRIEF-2	ToM	FQ	SR CATQ Total	SR Comp	SR Mask	SR Assim	PR CATQ Total	PR Comp	PR Mask
<b>IQ</b>	0.11											
<b>BRIEF-2</b>	-0.24	<b>-0.37*</b>										
<b>ToM</b>	-0.18	<b>0.45**</b>	<b>-0.37*</b>									
<b>FQ</b>	-0.06	-0.05	0.04	0.18								
<b>SR CATQ Total</b>	0.01	0.14	<b>-0.37*</b>	0.08	-0.21							
<b>SR Comp</b>	0.02	0.12	<b>-0.37*</b>	0.10	-0.02	<b>0.86***</b>						
<b>SR Mask</b>	0.02	0.18	<b>-0.41*</b>	0.01	0.08	<b>0.70***</b>	<b>0.49**</b>					
<b>SR Assim</b>	-0.01	0.14	-0.14	0.15	<b>-0.45**</b>	<b>0.72**</b>	<b>0.52***</b>	0.20				
<b>PR CATQ Total</b>	-0.06	0.24	-0.31	0.22	0.06	<b>0.53**</b>	<b>0.38*</b>	<b>0.62***</b>	<b>0.34*</b>			
<b>PR Comp</b>	-0.16	0.15	-0.13	0.01	0.10	<b>0.40*</b>	<b>0.33*</b>	<b>0.45**</b>	0.23	<b>0.86***</b>		
<b>PR Mask</b>	0.07	0.19	<b>-0.42**</b>	0.26	0.16	<b>0.35*</b>	0.29	<b>0.56***</b>	0.11	<b>0.80***</b>	<b>0.49**</b>	
<b>PR Assim</b>	-0.01	0.28	-0.11	0.21	-0.24	<b>0.54***</b>	0.20	<b>0.49**</b>	<b>0.57***</b>	<b>0.70***</b>	<b>0.52***</b>	<b>0.35*</b>

Note. BRIEF-2 = Behavioural Rating Inventory of Executive Function, 2<sup>nd</sup> Edition; ToM = Strange Stories test of Theory of Mind; FQ = Friendship Questionnaire; SR = Self Report; PR = Parent Report; CATQ = Camouflaging Autistic Traits Questionnaire; Comp = CATQ Compensation subscale; Mask = CATQ Masking subscale; Assim = CATQ Assimilation subscale. \* = p < .05, \*\* = p < .01, \*\*\* = p < .001

Age, IQ, and theory of mind were not correlated with any self- or parent-reported camouflaging scores. Parent-reported executive function difficulties were negatively correlated with self-reported total, compensation, and masking scores, and with parent-reported masking. Social motivation was negatively correlated with self-reported assimilation only.

Results of the eight multiple regressions in the total sample are summarised in Table 7.3. Results of analyses predicting self-reported and parent-reported camouflaging in separate female and male samples are reported in Tables 7.4 and 7.5 (Appendices 9 and 10). Assumptions of independence of errors and no multicollinearity were met in the total and both female and male samples.

Table 7.3 Summary of results from multiple regression analyses

Model 1: Total Self-Report CAT-Q

$R^2_{Adj} = 0.10$ ,  $F(5, 26) = 1.68$   $p = .18$

	B	$\beta$	p	95% CI
Intercept	202.25		.02	35.11 – 369.39
Age	-0.63	-0.03	.87	-8.29 – 7.03
IQ	0.22	0.12	.58	-0.57 – 1.01
<b>BRIEF-2</b>	<b>-1.05</b>	<b>-0.46</b>	<b>.03</b>	<b>-1.98 – -0.13</b>
ToM	-1.85	-0.16	.44	-6.71 – 3.01
FQ	-0.17	-0.11	.54	-0.72 – 0.38

Model 2: Self-Report Compensation

$R^2_{Adj} = 0.06$ ,  $F(5, 26) = 1.40$   $p = .26$

	B	$\beta$	p	95% CI
Intercept	52.21		.18	-25.26 – 129.69
Age	0.48	0.05	.78	-3.07 – 4.03
IQ	0.18	0.22	.31	-0.18 – 0.55
BRIEF-2	-0.40	-0.38	.07	-0.83 – 0.03
ToM	-1.03	-0.20	.36	-3.28 – 1.22
FQ	-0.01	-0.01	.96	-0.26 – 0.25

Model 3: Self-Report Masking

$R^2_{Adj} = 0.19$ ,  $F(5, 26) = 2.47$   $p = .06$

	B	$\beta$	p	95% CI
Intercept	66.07		.03	5.47 – 126.67
Age	-0.39	-0.05	.78	-3.16 – 2.39
IQ	0.15	0.20	.30	-0.14 – 0.43
<b>BRIEF-2</b>	<b>-0.45</b>	<b>-0.51</b>	<b>.01</b>	<b>-0.78 – -0.12</b>
ToM	-1.45	-0.33	.10	-3.22 – 0.31
FQ	0.15	0.26	.14	-0.05 – 0.35

Model 4: Self-Report Assimilation

$R^2_{Adj} = 0.08, F(5, 26) = 1.51 p = .22$

	B	$\beta$	p	95% CI
Intercept	54.27		.12	-14.63 – 123.18
Age	-0.17	-0.02	.91	-3.32 – 2.99
IQ	-0.01	-0.01	.99	-0.33 – 0.32
BRIEF-2	-0.10	-0.11	.60	-0.48 – 0.28
ToM	0.69	0.15	.48	-1.31 – 2.69
<b>FQ</b>	<b>-0.27</b>	<b>-0.44</b>	<b>.02</b>	<b>-0.50 – -0.05</b>

Model 5: Total Parent-Report CAT-Q

$R^2_{Adj} = 0.07, F(5, 25) = 1.43 p = .25$

	B	$\beta$	p	95% CI
Intercept	144.01		.05	1.16 – 286.86
Age	-3.06	-0.18	.34	09.59 – 3.46
IQ	0.23	0.15	.49	-0.45 – 0.92
BRIEF-2	-0.59	-0.30	.14	-1.39 – 0.21
ToM	1.08	0.11	.61	-3.19 – 5.36
FQ	0.17	0.14	.46	-0.30 – 0.64

Model 6: Parent-Report Compensation

$R^2_{Adj} = 0.04$   $F(5, 25) = 0797$   $p = .57$

	B	$\beta$	p	95% CI
Intercept	61.51		.08	=7.06 – 130.08
Age	-2.52	-0.28	.15	-5.38 – 0.89
IQ	0.12	0.17	.47	-0.21 – 0.44
BRIEF-2	-0.12	-0.13	.54	-0.50 – 0.27
ToM	0.01	0.01	.99	-2.04 – 2.06
FQ	0.08	0.13	.49	-0.15 – 0.30

Model 7: Parent-Report Masking

$R^2_{Adj} = 0.11$ ,  $F(5, 25) = 1.73$   $p = .16$

	B	$\beta$	p	95% CI
Intercept	40.55		.21	-24.28 – 105.29
Age	09.13	-0.02	.93	-3.09 – 2/83
IQ	0.03	0.04	.85	-0.28 – 0.34
<b>BRIEF-2</b>	<b>-0.37</b>	<b>-0.41</b>	<b>.046</b>	<b>-0.73 – -0.01</b>
ToM	0.50	0.11	.60	-1.44 – 2.44
FQ	.11	0.19	.29	-0.10 – 0.32

Model 8: Parent-Report Assimilation

$R^2_{Adj} = 0.01$ ,  $F(5, 25) = 1.02$   $p = .49$

	B	$\beta$	p	95% CI
Intercept	33.00		.12	-9.16 – 75.17
Age	-0.42	-0.08	.66	-2.35 – 1.50
IQ	0.09	0.21	.37	-0.11 – 0.29
BRIEF-2	-0.06	-0.11	.59	-0.29 – 0.17
ToM	0.48	0.17	.44	-0.78 – 1.74
FQ	-0.03	-0.09	.63	-0.17 – 0.10

Note. BRIEF-2 = Behavioural Rating Inventory of Executive Function, 2<sup>nd</sup> Edition; ToM = Theory of Mind task (Strange Stories); FQ = Friendship Questionnaire

None of the overall regression models were significant; however, in light of the small sample size, individual predictors are reported as preliminary findings. In the total sample, executive function difficulties negatively predicted self-reported total CAT-Q score and Masking, and the relationship between executive function and self-reported Compensation approached significance. Social motivation negatively predicted self-reported Assimilation. The only predictor of any parent-reported camouflaging was executive function difficulties, which negatively predicted parent-reported Masking.

In the exploratory analyses in each gender (reported in full in Appendices 9 and 10), only the model predicting self-reported Assimilation in females was significant ( $F[5,12] = 5.19$ ,  $p = .009$ ,  $Adj R^2 = 0.55$ ); within this model, social motivation negatively predicted assimilation and greater age marginally predicted greater assimilation. Self-reported masking was significantly predicted by greater IQ and lower theory of mind in females. In the other models, executive function difficulties predicted less self-reported masking

by males, and a lower self-reported total CAT-Q score in males. In females, there were trends towards IQ positively predicting parent-reported masking and assimilation, and social motivation positively predicting parent-reported masking. In males, there was a trend towards age negatively predicting self-reported assimilation, and executive function difficulties negatively predicting self-reported compensation. There was also a trend towards IQ positively and theory of mind negatively predicting self-reported masking in females.

## **7.5 Discussion**

### **7.5.1 Discussion of findings**

This study examined cognitive predictors of self-reported and parent-reported camouflaging in autistic adolescent males and females. In regression analyses, parent-reported camouflaging was not uniquely and significantly predicted by any variable, despite some significant bivariate correlations being observed. However, due to the small sample size and therefore increased risk of Type ii errors, replication in a larger, adequately powered sample is essential to determine whether relationships exist for both parent- and self-reported camouflaging.

Results relating to each predictor will be discussed in turn below.

#### **7.5.1.1 Age**

Age did not significantly differ between males and females, and was not a significant predictor of camouflaging in the total sample. Although our sample included adolescents aged between 13 and 17, the average age was 14 years and so there may not have been enough variation in ages to impact camouflaging ability. Alternatively, camouflaging intention may not develop during adolescence, and instead may have already developed by the age of 13. In Chapter 6, age was a significant predictor of camouflaging success in the total sample and approached significance in the male and female subsamples. This suggests that adolescents' ability to camouflage successfully may increase as they get older, but that autistic individuals of different ages may have similar intentions or

motivations to camouflage. Greater age marginally predicted greater assimilation in females, but did not predict any other self- or parent-reported camouflaging in the total sample or in males or females. These findings suggest that there may be different social expectations for girls and boys in earlier adolescence (Kågesten et al., 2016), which may result in greater camouflaging in order to fit in as girls get older. As both male and female samples were underpowered, it will be interesting to see if these relationships become significant in a larger sample.

#### 7.5.1.2 IQ

There was no difference in IQ between males and females. IQ was not significantly correlated with any measure of camouflaging, and did not predict any measure of camouflaging in the total sample. An association between IQ and masking was hypothesised by Livingston and colleagues (2018), who also suggested that compensation may involve more specific cognitive abilities and so IQ alone may not be enough to promote successful compensation strategies. Greater IQ predicted more self-reported masking in females, and there was a trend towards IQ positively predicting parent-reported masking and assimilation in females. IQ did not predict any camouflaging in males. Overall, the findings suggest that higher full-scale IQ is not necessary to promote overall camouflaging, particularly in males. This supports some previous research findings (Lai et al., 2017), and suggests that particular subdomains of IQ (such as verbal IQ) may play a greater role than general ability. However, as individuals with intellectual disability were not included in the study, we cannot generalise these findings across the entire range of intellectual abilities, although the findings suggest the need to explore camouflaging in individuals with lower intellectual abilities in the future.

#### 7.5.1.3 Executive Function

Individuals with more parent-reported executive function difficulties reported less total camouflaging, and less self- and parent-reported masking, in the total sample. In other words, individuals with better executive function camouflage more, in support of previous



hypotheses. In the male subsample, executive function difficulties also negatively predicted self- and parent-reported masking, and had no association with any measure of camouflaging in females. There are several possible implications of these findings. Greater executive function abilities may be needed in order to be able to mask, and therefore to camouflage overall, for instance by identifying, controlling, and regulating behaviours during social interactions.

Interestingly, the preliminary analyses in each gender suggest that these may be especially important for males, and may not influence camouflaging by females to the same extent, although it is important to emphasise that the analyses were underpowered to detect the predicted effects, and we did not directly test gender differences using moderation analyses due to the small sample size. There was no difference in executive function abilities between genders, in contrast to suggestions from previous literature that greater executive function in females may be one reason for greater camouflaging (Lehnhardt et al., 2015). It may be that autistic girls use other cognitive or social mechanisms to promote camouflaging, whereas boys use executive function abilities alongside or instead of these other hypothesised mechanisms. For instance, it has been proposed that executive function abilities may also enable greater social interaction from a younger age (as suggested by Livingston et al., 2018) which allows for camouflaging strategies to be developed and practiced. Autistic girls may have greater socialisation due to gendered expectations and peer relationships, which reduces the impact of executive function variation on camouflaging practices (Kreiser & White, 2014).

However, another, more plausible current explanation for the lack of relationship found in girls is lack of statistical power; the observed effects may simply be smaller in females and so harder to identify in the current small sample. It is possible that autistic girls may use alternative (compensatory?) strategies to identify their own camouflaging behaviours, without requiring greater executive function. Previous examination of the role of executive function using discrepancy-based approaches suggests that executive function does facilitate camouflaging, in adult females (Lai et al., 2017) or in mostly male

mixed samples (Livingston et al., 2018). Further examination in a larger sample would determine whether these non-significant findings represent true null effects.

#### 7.5.1.4 Theory of Mind

Males and females had equivalent scores on the Strange Stories theory of mind task; both gender scored highly although not necessarily at ceiling levels, with normal patterns of distribution seen in both samples. Theory of mind did not predict any aspect of camouflaging in the total sample, although greater theory of mind abilities predicted less self-reported masking in females, contrary to the hypothesised direction of this relationship. This relationship may represent some aspects of the 'high compensation' described by Livingstone and colleagues (2018), where individuals present with poor theory of mind and good behavioural presentation (ADOS score). Masking may be a response to poor theory of mind for girls; strategies such as practicing one's own and others' facial expressions may be a way to compensate for an implicit lack of understanding of mental states and emotions, which is not as necessary for girls with better theory of mind abilities.

However, it is not clear why this same relationship would not occur for males with poor theory of mind, or why the relationship was not observed for parent-reported camouflaging. It may be that the Strange Stories was not an accurate measure of theory of mind for these individuals; the measure had poor internal consistency for social stories but not for physical stories. As most participants were of average or above average intellectual ability, they may have used alternative cognitive routes to answer some of the Strange Stories questions, and so compensated for their theory of mind difficulties on some, but not all questions (Livingston & Happé, 2017). This could be tested by comparing participants' scores on different tests of theory of mind ability, across gender, cognitive ability, and age groups. Another likely explanation is that, due to underpowered sample sizes, any existing effects were not identified in the current analyses.

#### 7.5.1.5 Social Motivation

Social motivation was measured indirectly by score on the Friendship Questionnaire (higher scores representing greater interest and intensity of friendships). There was no difference in social motivation between genders. Social motivation predicted less self-reported assimilation in the total sample, and a trend towards lower self-reported assimilation, and higher parent-reported masking, in females. No relationship with total or subscale camouflaging was found in males. Overall, individuals with greater social motivation felt less need to force themselves to interact with others, and so reported less assimilation. This relationship may also reflect greater acceptance by their peers for those who put more effort in to social interactions, and therefore less forced socialisation (assimilation) as a result.

It has been suggested that girls' greater social motivation may help them develop more superficially successful social behaviours, perhaps by paying greater attention to the behaviours and expectations of their peers (Head, McGillivray & Stokes, 2014; Kok et al., 2016); this may account for the trend towards social motivation predicting greater parent-reported masking in the female subsample. Autistic females may be held to higher social standards than autistic males, reflecting typically-developing gendered socialisation (Kreiser & White, 2014; Lai et al., 2015), and this might lead to greater social motivation (due to a desire to meet these expectations), and greater camouflaging, especially masking of apparent differences which may lead to specific bullying or stigmatisation. Alternatively, the analyses may have been underpowered to detect significant associations between social motivation and camouflaging in males.

Autistic adults have self-reported that social motivation (or desire to develop relationships with others) is a key driver of their camouflaging (see Chapter 3 and Cage & Troxel-Whitman, 2019). In contrast, adolescents, especially males, may be more driven by the functional motivations for camouflaging that have also been reported; getting through education or social interactions while minimising stigmatisation. Secondary school can be a time of isolation, and bullying is especially common for autistic adolescents

(Campbell et al., 2017); this finding may therefore represent using camouflaging to 'get through' social situations with minimal negative consequences, rather than using camouflaging to enrich social relationships. Future work would benefit from including quantitative measures of experience of stigma or other functional motivations to explore the role this may play for adolescents, and to examine when motivations may change across development. The examination of camouflaging across different situations is also important to determine whether different types of camouflaging are used in response to different motivations or pressures, and therefore whether different underlying cognitive abilities are required across situations.

#### 7.5.1.6 Gender Differences in Camouflaging

This study represented the first use of observational/reflective quantitative examination of camouflaging in autistic adolescents, using both self-report and parent-report measures. Scores on the assimilation subscale were significantly higher for females than males, for both self-reported and parent-reported score, and total self-reported CAT-Q scores were higher for females than males as described in Chapter 6. Replication in a larger sample is needed to determine whether other gender differences, as reported in Chapter 5 and other studies (Lai et al., 2017), exist in adolescents as well as adults. Age was only a marginal predictor of self-reported assimilation in females, but both male and female samples were underpowered to detect the predicted effects. Age may have a greater impact in larger groups across a longer timeframe. However, autistic adolescent girls may feel greater expectation to fit in and adjust their behaviour accordingly than boys (assimilation), and this seems to be recognised by parents as well. It may be that assimilation strategies are some of the first used by autistic females to camouflage their autism, and that gender differences in the other areas of camouflaging emerge later in life as females develop their compensation and masking strategies more fully.

Examination of mean scores indicates that estimates of total camouflaging and compensation and masking were broadly similar between parents and self-report. Parents may have underestimated the extent to which their daughters masked their

autistic characteristics, although this is unsurprising as many masking strategies may be hard to identify externally (e.g. monitoring and adjusting facial expressions). Parents estimated males' total camouflaging and compensation as higher than self-reported by young people; this may reflect limited self-awareness by adolescent males, or over-identification by parents.

### 7.5.2 Strengths and Limitations

A key strength of this study is that it was the first to empirically examine self- and informant-reported camouflaging in autistic adolescents, testing hypotheses which have mostly been examined in adult samples. In addition, an equal number of males and females allowed for preliminary comparison of gender differences in cognitive mechanisms, which have not previously been explored in such detail. These analyses have revealed some potential hypotheses for gender differences in the cognitive mechanisms underlying camouflaging, which should be explicitly tested through moderation analyses in samples large enough to capture the effect sizes estimated in this study. The relationships between cognitive and individual characteristics and camouflaging identified in each gender in these analyses have implications both for our conceptualisation of the process of camouflaging, and for the support of camouflaging and its consequences in adolescent girls and boys. However, at the time of these analyses the male and female samples were substantially underpowered to detect the anticipated effects, which likely accounts for some non-significant findings. Data collection is ongoing with the aim to replicate these analyses with an appropriately large sample.

Another limitation is that only correlational relationships between cognitive predictors and camouflaging were established. It is imperative to conduct longitudinal studies to examine the causal relationships between camouflaging and cognitive abilities; for instance, it may be that greater executive function enables more camouflaging, or that more experience of camouflaging leads to the development of better executive function abilities.

Social motivation and executive function were measured through self- or parent-report questionnaires, rather than directly through behavioural tasks. While these allowed for faster data collection in an already lengthy assessment period, future research should compare multiple different measures of these individual abilities to ensure they are measured as accurately as possible. Behavioural measures of executive function have limited clinical utility (Demetriou et al., 2018); however, they may identify aspects of cognitive ability which influence camouflaging in ways parents are not aware of.

### 7.5.3 Future research

As described above, future research should focus on longitudinal research to identify the causal relationships between camouflaging and associated cognitive mechanisms. This is particularly important when considering the differences in socialisation that males and females experience during development, which may have unique impacts for autistic individuals (Kreiser & White, 2014; Lai et al., 2015). Different social and cognitive factors may interact to produce different levels of camouflaging, and, as reported in Chapter 6, varying degrees of success. These may have different impacts on the long-term wellbeing and outcomes associated with camouflaging in autistic individuals.

Another important area of future research is to examine the neural mechanisms and structures associated with these cognitive predictors. The prefrontal cortex is most strongly associated with executive function abilities, and has already been proposed as a key neural site for camouflaging (Livingston & Happé, 2017). Another potential cognitive mechanism not explored in the current study is self-representation, the neural correlates of which were found to be associated with camouflaging in autistic men but not women (Lai et al., 2018). Brain imaging while an individual engages in camouflaging may reveal other, previously unconsidered cognitive mechanisms involved, including those which individuals may not be able to report on themselves.

#### 7.5.4 Conclusions

This chapter identified specific cognitive and individual characteristics which influence self-reported camouflaging in adolescents. Specifically, total camouflaging and the masking component are associated with fewer executive function difficulties, and the assimilation component is associated with lower social motivation. Preliminary analyses suggested that different cognitive factors may influence camouflaging between genders, with executive function having specific influence for males, and social motivation and theory of mind for females; however sample sizes were substantially underpowered to detect predicted effects. These findings provide insights into some of the factors which may determine the success of camouflaging and associated outcomes, including poor mental health. The findings provide many hypotheses for future work, and should be replicated in larger and more variant samples.

## **CHAPTER 8: GENERAL DISCUSSION**

### **8.1 Summary and interpretation of key findings**

This thesis aimed to conceptualise camouflaging behaviours in autistic individuals and develop a valid, reliable questionnaire method of measuring camouflaging which could be used to consider the role of camouflaging in the female autism phenotype. This chapter will discuss the findings of the thesis in relation to the foregoing aims, and consider the implications for research, policy, and clinical practice. Some general reflections on the strengths and limitations of the methods used will be discussed, along with avenues for future research arising from this thesis.

#### **8.1.1 Conceptualisation of camouflaging**

Prior to this thesis, there had been very limited conceptualisation of camouflaging behaviours in autism, although the relevant literature expanded significantly during the course of this thesis. Camouflaging had been conceptualised as the use of strategies, whether consciously or not, to adapt one's behaviour in order to appear less autistic to others (Lai et al., 2011; Wing, 1981a). Chapter 3 detailed an exploratory study to define and conceptualise camouflaging, based on autistic adults' own camouflaging experiences. Camouflaging is motivated by the desires to fit in to everyday life, and to form connections with other people. These motivations were supported by the further finding that autistic adolescents who camouflage more make better first impressions, suggesting this aim of camouflaging can be achieved (Chapter 6). Camouflaging motivations have also been supported by recent research identifying underlying factors in self-reported reasons for camouflaging (Cage & Troxell-Whitman, 2019). The two components identified were categorised as 'conventional' (such as getting a job, or getting others to take you seriously), and 'relational' (such as to make friends or seem attractive to others). These two components overlap with the motivations of 'assimilation' and 'to know and be known' identified in Chapter 3, suggesting that these themes can



be reliably identified as motivations for camouflaging across different samples and research groups.

#### 8.1.1.1 Camouflaging Strategies

Camouflaging strategies described in Chapter 3 included compensation for autism-related social difficulties, and masking of autistic behavioural characteristics. These factors of camouflaging were also identified through exploratory factor analysis of items in the Camouflaging Autistic Traits Questionnaire (CAT-Q), as reported in Chapter 4. This suggests that these are true facets of camouflaging as they were identified across varying samples of autistic adults, through a variety of methods. An additional CAT-Q factor of assimilation reflects some of the additional motivations reported in Chapter 3, to fit in with others and comply with social norms, as well as the artificial nature of social interaction when camouflaging described by some participants in Chapter 3. The distinct nature of these components of camouflaging was supported by the finding in Chapter 7 that different cognitive processes are associated with the different CAT-Q factors. Specifically, masking of autistic traits may require greater executive function to inhibit specific autistic behaviours, especially in males; and assimilation strategies may be used by individuals with lower social motivation, especially females. However, the samples in which the associations between these abilities and camouflaging were examined, especially the gender-specific subsamples, were underpowered and so these results are presented as preliminary. No cognitive predictors of the factor of compensation were identified, suggesting that further research is also needed to understand how compensation strategies overlap with or differ from other camouflaging strategies, and with the concept of compensation as described by Livingston and colleagues (2018).

#### 8.1.1.2 Consequences of camouflaging

Although some positive consequences of camouflaging were reported in Chapter 3, such as challenging stereotypes or avoiding discrimination, camouflaging was almost universally described as exhausting and can also impact autistic individuals' self-esteem and sense of identity. This supports previous and contemporary qualitative and

quantitative research into camouflaging (Bargiela et al., 2016; Cage et al., 2017; Lai et al., 2017). CAT-Q score and factor scores were associated with greater levels of depression, anxiety, and social anxiety in an adult sample (Chapter 4), giving empirical evidence to the observation that camouflaging has a negative impact on wellbeing. Camouflaging is an inherently social behaviour, although some respondents in Chapter 3 reported that they find themselves using these strategies even when alone. Adolescents who reported camouflaging more formed better social impressions on others (Chapter 6), suggesting that there can be some positive outcomes associated with camouflaging across ages. However, this also links with the observation in Chapter 3 that camouflaging by females in particular may lead to overestimation of abilities and underestimation of need for support, with the potential implication of underdiagnosis of autism in females.

### **8.1.2 Measurement of camouflaging**

Different approaches to measuring camouflaging were discussed and evaluated in Chapter 1. The need for a reflective/observational approach to measuring camouflaging, which is grounded in autistic adults' own experiences and perceptions, was emphasised. Using the conceptual model developed in Chapter 3, and camouflaging strategies reported by participants in that study, academic and clinical experts, and other autistic adults, self-report items measuring camouflaging were developed and evaluated to form the final Camouflaging Autistic Traits Questionnaire (CAT-Q; Chapter 4). The questionnaire was tested, refined, and validated in a large sample of autistic adults, and was also validated in non-autistic adults to overcome potential issues of diagnostic bias discussed in Chapter 1. Convergent validity was tested through comparison with autistic traits and mental health outcomes, and good internal consistency and test-retest reliability were demonstrated. The three component subscales, Compensation, Masking and Assimilation, are conceptually related to the motivations and processes of camouflaging identified in Chapter 3.

#### **8.1.2.1. Evaluation of the CAT-Q**

The practicality of using the CAT-Q in different clinical and non-clinical samples was also evaluated in this thesis. Using confirmatory factor analysis, measurement invariance was demonstrated in autistic and non-autistic males and females, allowing for the comparison of gender differences free from measurement bias (Chapters 4 and 5). Although developed with an adult sample, the preliminary feasibility of using the CAT-Q in an adolescent sample was examined in Chapter 6. The self-report CAT-Q was also compared to a parent-report version, and another measure of camouflaging previously used in research, to further test concurrent validity (Chapter 6). Self-report and parent-report versions of the CAT-Q were well correlated, at correlation coefficients equal to or greater than those often reported for self- and informant-report versions of well-established instruments such as the SDQ (Goodman, Meltzer, & Bailey, 2003). Both self- and parent-report CAT-Q demonstrated excellent internal consistency in the total and male and female adolescent samples. The self-report CAT-Q can be used to measure adolescents' camouflaging, and a parent-report version appears to measure similar levels of these behaviours.

Both self- and parent-report CAT-Q were moderately correlated with another established measure of camouflaging, providing further concurrent validity for the CAT-Q as a measure of the latent construct of camouflaging. The parent-report CAT-Q was found to predict a proxy measure of camouflaging success (positive impression formed when camouflaging), as an additional test of the measure's convergent validity; and was a better predictor of this outcome than other measures of camouflaging or of social skills (Chapter 6). This may reflect differences in the components of camouflaging measured by the self- and parent-report CAT-Q. Self-report CAT-Q scores may reflect intention to camouflage, whereas parent-report CAT-Q scores may reflect the behavioural effort and success put into camouflaging, as observed by an informant. While both may still tap into the latent concept of camouflaging, further research is needed to identify exactly which items in each questionnaire measure camouflaging intention as opposed to success, in order for these to be used appropriately. This is supported by the findings of Chapter 7,

where only one aspect of parent-reported camouflaging was predicted by any cognitive mechanisms (masking), suggesting that parent-reported measures may not capture more subtle features of camouflaging intention influenced by cognitive abilities. Overall, the self-report CAT-Q is a good measure of camouflaging intention in adults and adolescents, and may be supported by the use of the parent-report CAT-Q as an additional measure of camouflaging.

### 8.1.3 Camouflaging and the female autism phenotype

Evidence for the existence of a female-specific behavioural expression of additional characteristics of autism was presented in Chapter 2, which also emphasised that to determine whether a behaviour forms part of the female autism phenotype, gender differences in both autistic and non-autistic individuals must be compared. However, gender differences in the core characteristics of autism did not vary between diagnostic groups in these analyses, supporting the argument that some previously observed autistic gender differences may reflect general population gender differences, rather than differences unique to autism. These findings suggested that continued examination of camouflaging as a hypothesised component of the female phenotype was warranted, especially as camouflaging ability itself does not represent a core characteristic of autism.

#### 8.1.3.1 Gendered experiences of camouflaging

Respondents in Chapter 3 suggested that autistic women may miss out on diagnosis and support because of their camouflaging strategies, with some suggesting that females are more successful at camouflaging even if all genders camouflage to some extent. This was supported by the demonstration in Chapter 5 of higher camouflaging scores in autistic adults than non-autistic adults, with autistic females camouflaging significantly more than autistic males, and no gender difference in non-autistic adults. These findings suggest that camouflaging may be more common in autistic females than males (fulfilling the diagnostic group and gender-based comparisons recommended in Chapter 2), although gender differences may only be moderate and reflect significant within-gender

variation. However, it is important to bear in mind that autistic males still camouflage at high levels, and therefore that the negative implications of camouflaging described in Chapters 3 and 4 are still likely to affect autistic males, and that there may also be impacts for non-autistic individuals with high levels of autistic traits.

### *8.3.1.2 Gendered mechanisms of camouflaging*

Chapter 6 provided preliminary evidence for gender-specific relationships between camouflaging intention and success, as autistic adolescent girls' camouflaging strategies predicted the positive impression they form on others, whereas the relationship for adolescent boys was not statistically significant. More successful camouflaging (as determined by more positive impressions being made) may lead to underestimation of the support needs of autistic girls and women, as proposed in Chapter 3. Some gender-specific cognitive mechanisms were also proposed in Chapter 7, although samples were underpowered to draw firm conclusions. Executive function abilities may play a greater role in camouflaging for males than for females.

Total self-reported camouflaging levels were greater in adolescent females than males (as described in Chapters 6 and 7), supporting the previous findings of greater female camouflaging. However, total parent-reported camouflaging levels were not significantly different, suggesting that aspects of camouflaging which may be more observable to others may not differ between genders, at least in adolescence.

### *8.1.1.3 Camouflaging and the male autism phenotype*

A somewhat surprising findings of Chapter 3 was that the great majority of autistic males in this sample reported camouflaging their autism at some point their life. Although camouflaging scores were lower in autistic adult males than females (Chapter 5), males still camouflaged to a greater extent than non-autistic males or females. These findings, and the lack of gender differences in parent-reported camouflaging in the adolescent samples in Chapters 6 and 7, suggest that camouflaging should not be thought of as an exclusively female autistic behaviour. Camouflaging appears to form part of the

behavioural expression of autism for individuals of all genders, and future research should not limit itself by restricting examination of camouflaging to females only.

The findings of this thesis support some previous and concurrent research into camouflaging, which identified equivalent levels of camouflaging in autistic males and females (Cage & Troxell-Whitman, 2019; Livingston et al., 2018). Other research has also emphasised that unique mechanisms may be involved in camouflaging effort and success for males (Lai et al., 2018), and that males in particular may be at risk of depression as a result of their camouflaging efforts (Lai et al., 2017). Although this thesis aimed to study camouflaging in the context of female-specific expressions of autism, it has revealed that camouflaging may also play a significant part in the male expression of autism. The proposed consequences of camouflaging which may lead to under-diagnosis of autism in females may therefore also apply to (some) males, although it remains to be seen whether camouflaging success is similar and has the same impact on autism diagnosis across genders.

## 8.2 Strengths and limitations

### 8.2.1 Methodologies

Two key methodologies were used in this thesis, in addition to literature review and meta-analysis (Chapters 1 and 2). The first involved large-scale online samples of adults completing anonymised surveys. This approach allowed for the integration of a wide variety of perspectives during the qualitative conceptualisation study (Chapter 3), including some contradictory perspectives which suggested the relationship between gender, camouflaging, and positive outcomes may be more nuanced than had previously been proposed. An inductive approach was taken at the start of this approach, with research questions and measures driven by the responses of participants in Chapter 3, which then moved to a deductive approach where hypotheses developed partly from these responses were examined in the rest of the thesis.

Another strength of this first methodology is that the anonymity may have allowed for more open or honest responses than might have emerged during in-person or telephone interviews, where social desirability bias, differences in communication preferences, or other factors may have prevented participants from disclosing their full experiences. These samples contained an unusually high proportion of female and non-binary individuals, which provided previously underreported insights, but may also be seen as unrepresentative of the mostly male autistic population. The large numbers of participants allowed for more precise validation of the CAT-Q (Chapter 4), particularly with regards to demonstrating measurement invariance across autistic and non-autistic males and females. This is a unique strength of this thesis and has allowed future research, reported in this thesis (Chapter 5) and elsewhere (Cage & Troxell-Whitman, 2019), to examine gender and diagnostic group differences in a variety of populations using the CAT-Q.

However, a limitation of this methodology is that, since all participants were anonymous, autism diagnoses could not be independently confirmed – although participants who reported being self-diagnosed were excluded from analyses. Additionally, by using an online, text-based format for these studies, participants who found it harder to express themselves in written English may have been excluded. As such, the conclusions of Chapters 3, 4 and 5 cannot be generalised to individuals with lower cognitive or verbal ability, or to individuals from non-English speaking countries.

The second methodology, utilised in Chapters 6 and 7, involved in-person assessments of autistic adolescents, measuring a variety of cognitive and behavioural characteristics. This approach overcame some of the limitations described previously, such as external confirmation of autism diagnosis; parents of all participants confirmed their child's autism diagnosis, gave details of the diagnostic service and age at diagnosis, and in many cases participants were identified on the basis of their medical records confirming such a diagnosis. By using in-person behavioural assessments there was greater adaptation to participants' individual needs (such as reading questionnaire items aloud and recording

the participant's oral answer), which allowed for a broader range of abilities to be included. This approach also allowed for task-based assessment of some abilities (for instance, theory of mind as in Chapter 7), ensuring that measures were not reliant on self-report and the potential biases which may accompany this.

The extensive time and energy demand of completing these in-person assessments may, however, have led to the key limitation of this approach. The total number of adolescent participants recruited by the time of the analyses reported here was substantially below the target samples, and led to analyses being underpowered to detect the predicted effects. One reason for this may have been that the study took around 2-3 hours for each participant to complete and, due to limited resources, no financial compensation was available to families (although adolescent participants were entered into a lottery to win gift vouchers). Recruitment for the studies reported in Chapters 6 and 7 took place over a period of 18 months, but complications in arranging contracts with local NHS trusts meant that most recruitment took place through social media, word of mouth, and support groups rather than through NHS patient records. The author was aided in recruitment by three trainee clinical psychologists, who joined the project approximately nine months into recruitment. These students will continue to collect data with the aim of reaching target samples in the future, at which point data will be re-analysed before publication of the results in academic journals.

### 8.2.2 Participatory research

During the course of this thesis, there has been increasing attention to and discussion of the use of participatory research; research which incorporates the values and opinions of autistic people and others associated with them, and which seeks to balance power dynamics between researchers and participants (Fletcher-Watson et al., 2018). Increasing the participatory nature of research increases the meaningful impact of research findings, both in terms of relevance for the populations involved, and the likelihood of findings being shared, discussed, and responded to. Participatory research



should aim to involve individuals affected by the research at every stage of research, from conceptualisation to study design, to analysis and interpretation, to dissemination.

Parts of this thesis were conducted in participatory ways; for instance, responses from autistic adults were used to develop the conceptual model described in Chapter 3, while items and phrasing for the CAT-Q were developed through consultation with autistic adults, autistic researchers, and clinicians. Materials for the studies reported in Chapters 6 and 7 were reviewed by autistic parents and adolescents for readability, and suggestions made were incorporated – such as the use of images to note which aspects of the interview would be video recorded. However, a significant limitation of this thesis is the lack of participatory features throughout the thesis design. No autistic insights were included in the development of the online questionnaires used in Chapters 3-5, and no autistic researchers or other members of the autism community were, to the author's knowledge, consulted on any aspect of methodology or analysis. Future research into camouflaging should ensure that studies are conducted in participation with members of the autistic and autism communities at every stage.

### 8.3 Implications

#### 8.3.1 Implications for research

This thesis has contributed significantly to both the conceptualisation and measurement of camouflaging in autism. The findings of Chapter 2 suggested that a female autism phenotype may exist, but that researchers must take into account gender differences in the general population before assuming gender differences in autistic participants represent a unique female behavioural expression of autism. The conceptual model described in Chapter 3 has provided a theoretical framework for other researchers to explore the components of camouflaging and how they relate to each other. Perhaps most importantly, the development of the CAT-Q as described in Chapter 4 has enabled researchers to measure camouflaging in a simple, easily administered, and psychometrically valid method for the first time. The findings of Chapters 5 and 6 provide

hypotheses regarding the development of camouflaging across genders, and the relative success, which can be tested in future longitudinal and cross-sectional research, while future researchers can use the cognitive predictors identified in Chapter 7 to focus the hypotheses of future experimental and observational studies.

This thesis provides evidence that camouflaging forms part of the female autism phenotype, thereby supporting the existence of gender-based variation in behavioural presentation of autism. This has implications for the future study of autism, particularly when considering the representativeness of research samples. Studies involving entirely or mostly male participants which seek to generalise their findings to all autism should be mindful of the substantial number of female participants who may express their autism in different ways, in addition to the significant under-diagnosis of female and non-binary individuals. However, this thesis also demonstrated for the first time that camouflaging is also common amongst autistic males, although potentially at lower levels; camouflaging may therefore also form a part of the male autism phenotype. Future studies attempting to identify the 'true' nature of autism should use the conclusions from this thesis to ensure that their samples are representative of a variety of presentations and genders in order to fully capture the true variety of autistic experiences.

### 8.3.2 Implications for policy

There are implications of this thesis for clinical and national policy. The most important is that an awareness of camouflaging, and the possible impact it may have on behavioural presentation of autism and mental health, should be integrated to clinical policies, such as NICE autism diagnostic guidelines. There has been some progress in this area already; the most recent edition of the International Classification of Diseases (World Health Organization, 2018) describes for the first time the possibility that autistic behaviours may be hidden earlier in life but may come to light when other abilities reach their limit. This could be further expanded and adapted to specify that some autistic characteristics may only be expressed in certain situations, and in particular that the semi-structured interactions often used as part of diagnostic assessments may serve to

hide some more subtle autistic characteristics. The finding that a very large proportion of autistic adults camouflage to some degree suggests that the NHS and other national healthcare systems should include a measure of camouflaging during diagnostic assessments, with the implication of reducing diagnostic bias against females. Improving access to adult diagnostic assessments is an important policy change which may allow autistic individuals who have camouflaged their whole lives to access support and gain self-understanding.

The potential negative consequences of camouflaging, particularly related to mental health, also suggest changes to intervention policies. Many of the strategies described as part of camouflaging are conceptually similar to components of psychosocial interventions currently promoted by the National Autistic Society and NICE Guidelines for management of autism in under 19s (National Institute for Health and Care Excellence, 2013), such as improving joint attention or reciprocity through learning and reinforcement. These interventions in particular may result in compensatory strategies of the 'shallow' type (Livingston & Happé, 2017), as opposed to 'deep' or implicit changes in social cognition. It is still not clear to what extent these interventions lead to increased camouflaging, or whether explicitly taught social skills have the same impact as self-developed camouflaging. However, the troubling implications of this thesis are that camouflaging, and therefore social skills interventions which promote the use of camouflaging strategies, may lead to mental health problems in the future. More research is necessary to examine this link, but policy makers should be wary of promoting these interventions until more is known.

### 8.3.3 Implications for practice

The findings of this thesis can be used immediately by clinicians and other practitioners working in autism-related fields. In particular, the CAT-Q can be used as a quick and easy measure of camouflaging with patients, either during or after an autism diagnostic assessment, to determine 1) whether the individual's autistic characteristics may be camouflaged, and so less visible in a traditional diagnostic assessment, and 2) whether

the individual may be at risk of experiencing additional mental health problems as a result of camouflaging. The CAT-Q is already being used by clinicians across the UK and in other countries, and since it is freely available through an open access publication, any clinician or practitioner who wishes to use it in the future can do so. However, further clinical research is needed before the CAT-Q can be incorporated as part of the diagnostic assessment process.

An additional implication of the thesis is that practitioners' awareness of what autism looks like should be broadened, particularly for females or non-traditional presentations. The female autism phenotype, which most likely includes camouflaging of autistic characteristics, may mean that individuals do not meet traditional diagnostic criteria on current assessment tools, but may still experience difficulties associated with autism. Clinicians, GPs, teachers, educational psychologists, and any other individuals who have the ability to refer, diagnose, or recommend adaptations related to autism, should be mindful of these different presentations at the risk of discriminating against some autistic individuals. It is also important to emphasise that, although camouflaging likely forms part of the female autism phenotype, individuals of all genders may camouflage their autism to some extent. Practitioners should therefore not assume that non-female individuals might not also camouflage some aspects of their autism, even if they still meet diagnostic criteria in other areas.

#### 8.4 Unanswered questions

A number of questions remain unanswered following this thesis, and still more have been raised during the course of these studies. Firstly, the stability of camouflaging across different situations and timepoints needs to be examined. Reports from Chapter 3 suggested that many autistic adults vary their camouflaging depending on the social and sensory demands of their environment, as well as who they are with, and the inconsistent findings regarding gender differences in self- and parent-reported camouflaging (Chapters 6 and 7) suggest that some more successful and/or visible camouflaging strategies might be used at similar levels in adolescence. The immediate next step in

researching camouflaging is to undertake longitudinal studies examining how camouflaging develops and changes from childhood through to adulthood, and whether different situational factors affect the extent or outcome of camouflaging. Most research into camouflaging, in this thesis and by other researchers, has so far relied on self-report or laboratory-based measures of camouflaging, which do not represent dynamic camouflaging strategies used in real-life interactions. It is therefore imperative to examine camouflaging during realistic interactions with varying social demands, and with a variety of interpersonal relationships, to better understand why and how camouflaging develops and is maintained.

Secondly, the findings of Chapters 6 and 7 suggest that autistic adolescents do camouflage to some extent, and that both self-report and informant-report methods may be used to measure camouflaging in these age groups. However, it remains to be seen whether younger children camouflage in similar ways, and the utility of reflective/observational measures of camouflaging should be tested in younger populations. The cognitive mechanisms identified in Chapter 7 provide some insight into how camouflaging may develop, but further research is needed to understand exactly how different cognitive abilities lead to different behavioural outcomes, and to consider the potential costs or benefits of using these strategies as a developing young person. In particular, further research in adequately powered samples is necessary to explore the potentially moderating role of gender in both the success and cognitive mechanisms of camouflaging.

Thirdly, it is important to measure camouflaging in populations that have not received as much attention – such as individuals who identify as transgender or non-binary and those who have not received a formal autism diagnosis. Autistic individuals of non-traditional genders may experience even greater social pressure to fit in, but may also find it harder to identify gender-appropriate social behaviours to compensate for or mask with. In addition, these populations are at even greater risk of mental health problems than cisgender autistic males and females (Øien, Cicchetti, & Nordahl-Hansen, 2018), and so

the potential mental health consequences of camouflaging may be even more pressing for this group. Adults who identify as self-diagnosed, but do not seek or have not obtained a formal autism diagnosis, are also highly likely to camouflage their autistic characteristics. It is important to examine how successful this camouflaging may be, to determine the costs and benefits of camouflaging over a longer period of time. Although gender differences in camouflaging intention and success were observed in the formally-diagnosed samples included in this thesis, it is also important to examine camouflaging in non-diagnosed individuals of all genders. The analyses reported in Chapter 5 were underpowered to detect differences between non-binary autistic individuals and other groups; however preliminary results suggest non-binary autistic people may also camouflage at high levels. Further research in larger samples is needed to confirm this. Camouflaging may be equally common across genders for autistic adults who have not yet received a diagnosis.

A final unanswered question concerns the role of camouflaging in the female autism phenotype. This thesis suggests that there are gender differences in the extent of camouflaging in autistic adults, and in the success of camouflaging in autistic adolescents. However, it is still unclear to what extent this directly impacts clinical diagnosis – are autistic females less likely to receive an autism diagnosis because they camouflage, or is camouflaging a relatively small component of the female autism phenotype that leads to diagnostic gender bias? Future research should explicitly test the role of camouflaging in relation to other proposed components of the female autism phenotype, to determine which changes to diagnostic practice will have the most beneficial impact. As described above, research should also examine the extent to which camouflaging may impact diagnosis for males and individuals of non-binary gender.

## 8.5 Concluding remarks

Social camouflaging is a behavioural strategy used to compensate for and mask autistic characteristics with the aim of fitting in and forming connections with others. This thesis developed a conceptual model of camouflaging and a self-report measure of

camouflaging strategies, which has been used in adult and adolescent samples. This will allow future research to better understand and measure camouflaging, and can be used in clinical settings to improve autism diagnosis and identify potential negative consequences of camouflaging. Studies with autistic adults and adolescents demonstrated that camouflaging is more common and more successful for females than males. The implications of these findings are that camouflaging may be one component of a behavioural presentation of autism that is more common in females, and this may contribute to the underdiagnosis of autism in girls and women.

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## APPENDIX 1

Table 2.1. Sample characteristics of studies included in review in Chapter 2

Paper	Authors (Date)	ASD symptom(s) assessed	Autistic group diagnoses at time of study	ASD diagnostic criteria used	How diagnosis confirmed	Autistic Group			Typically Developing Group		
						Males (n)	Females (n)	Mean age (years)	Males (n)	Females (n)	Mean age (years)
1	Baron-Cohen et al. (2014)	Empathising traits Systemising traits Autism traits	AS (62%) ASD (29%) HFA (5%) PDD (2%) Autism (1%)	Not reported	Not reported	357	454	34.7	1344	2562	34.4
2	Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright (2003)	Empathising traits Systemising traits	AS/HFA (proportions not reported)	DSM-IV criteria for Autism/ AS	Not reported	33	14	38.1	114	164	30.9
3	Baron-Cohen & Wheelwright (2004)	Friendships	AS/HFA (proportions not reported)	DSM-IV criteria for Autism/ AS	Not reported	51	17	34.4	27	49	40.5

Paper	Authors (Date)	ASD symptom(s) assessed	Autistic group diagnoses at time of study	ASD diagnostic criteria used	How diagnosis confirmed	Autistic Group			Typically Developing Group		
						Males (n)	Females (n)	Mean age (years)	Males (n)	Females (n)	Mean age (years)
4	Baron-Cohen et al., (2001)	Autism traits	AS/HFA (proportions not reported)	DSM-IV criteria for Autism/ AS	Not reported	45	13	31.6	76	98	37
5	Bölte, Duketis, Poustka, & Holtmann (2011)	IQ Executive functions	Autism (68%) AS (20%) PDD-NOS (13%)	ICD-10 criteria for Autism/ AS/PDD- NOS	Clinician assessment & ADI-R /ADOS	35	21	14.2	23	35	14.6
6	Dean et al. (2014)	Friendships	ASD (100%)	Not reported	Clinician assessment & ADOS	25	25	7.5	25	25	7.8
7	Goddard, Dritschel, & Howlin (2014)	IQ Memory	ASD (100%)	DSM-IV- TR criteria for ASD	Clinician assessment & SCQ	12	12	12.9	12	12	12.6

Paper	Authors (Date)	ASD symptom(s) assessed	Autistic group diagnoses at time of study	ASD diagnostic criteria used	How diagnosis confirmed	Autistic Group			Typically Developing Group		
						Males (n)	Females (n)	Mean age (years)	Males (n)	Females (n)	Mean age (years)
8	Harrop, Green & Hudry (2016)	IQ Play behaviours	ASD (100%)	Not reported	ADI-R /ADOS	14	14	3.8	14	12	2.0
9	Head, McGillivray, & Stokes (2014)	Friendships	ASD (not including LFA or PDD- NOS; 100%)	Not reported	Not reported	25	25	13.7	26	25	12
10	Holt et al. (2014)	IQ Theory of mind	AS/HFA (proportions not reported)	Not reported	ADI-R /ADOS	33	16	14.6	20	20	15.1
11	Kirkovski, Enticott, Hughes, Russell & Fitzgerald (2016)	IQ Social impairments RRBIs Empathising traits Autism traits	AS (85%) HFA (15%)	DSM-IV- TR criteria for ASD	Viewing of clinician diagnostic report	13	14	30.7	11	12	30.7

Paper	Authors (Date)	ASD symptom(s) assessed	Autistic group diagnoses at time of study	ASD diagnostic criteria used	How diagnosis confirmed	Autistic Group			Typically Developing Group		
						Males (n)	Females (n)	Mean age (years)	Males (n)	Females (n)	Mean age (years)
12	Knickmeyer, Wheelwright & Baron-Cohen (2008)	Play behaviours	Of those available (91% of total sample): AS (32%) Autism (58%) HFA (3%) PDD-NOS (3%) Atypical Autism (2%)	ICD-10 or DSM-IV criteria for ASC	Not reported	46	20	10.2	31	24	5.2
13	Lai et al. (2012)	IQ Executive functions Theory of mind Memory	AD/AS (proportions not reported)	ICD-10 or DSM-IV criteria for ASC	ADI-R /ADOS /AAA	32	32	27.6	32	32	28.2
14	Lemon, Gargaro, Enticott, &	IQ Executive functions	HFA (70%) AS (30%)	DSM-IV criteria for HFA/AS	Clinician assessment	10	13	11	8	14	11.4

Paper	Authors (Date)	ASD symptom(s) assessed	Autistic group diagnoses at time of study	ASD diagnostic criteria used	How diagnosis confirmed	Autistic Group			Typically Developing Group		
						Males (n)	Females (n)	Mean age (years)	Males (n)	Females (n)	Mean age (years)
15	Rinehart (2011) May, Cornish & Rinehart (2012)	Social impairment Communication impairment RRBIs IQ Inattention/ hyperactivity	AS (64%) AD (36%)	DSM-IV- TR criteria for AS/AD	Viewing of clinician diagnostic report	32	32	9.9	30	30	9.3
16	Oswald et al. (2016)	IQ Internalising problems	ASD (100%)	Not reported	AQ/ASDS	18	14	14.8	18	14	14.9
17	Park et al. (2012)	Social impairment Communication impairment RRBIs IQ	ASD (100%)	DSM-IV-R criteria for PDDs	Clinician assessment	91	20	8.3	26	25	8.6

Paper	Authors (Date)	Internalising problems Externalising problems ASD symptom(s) assessed	Autistic group diagnoses at time of study	ASD diagnostic criteria used	How diagnosis confirmed	Autistic Group			Typically Developing Group		
						Males (n)	Females (n)	Mean age (years)	Males (n)	Females (n)	Mean age (years)
18	Sedgewick, Hill, Yates, Pickering & Pellicano (2015)	Social impairment IQ Friendships	Autism (83%) AS (17%)	DSM-IV- TR or ICD-10 criteria for autism/ AS	Clinician assessment and statement of special educational needs indicating autism	10	13	13.9	10	13	13.8
19	Solomon et al. (2012)	Social impairment Communication impairment RRBIs IQ	ASD including HFA, AS & PDD-NOS (proportions not reported)	DSM-IV- TR criteria for AD/AS/ PDD- NOS	ADOS/SDQ	20	20	12.2	17	19	12

Paper	Authors (Date)	Internalising problems ASD symptom(s) assessed	Autistic group diagnoses at time of study	ASD diagnostic criteria used	How diagnosis confirmed	Autistic Group			Typically Developing Group		
						Males (n)	Females (n)	Mean age (years)	Males (n)	Females (n)	Mean age (years)
20	Zwaigenbaum et al. (2012)	Social impairment Communication impairment RRBIs IQ	Not reported	DSM-IV- TR criteria for ASD	Viewing of clinician diagnostic report & ADI- R/ ADOS	57	28	3.3	64	64	3.3
						55	25	3.3	63	63	3.3

*Note.* AAA = Adult Asperger Assessment; AD = Autistic Disorder; ADI-R = Autism Diagnostic Interview (Revised); ADOS = Autism Diagnostic Observation Schedule; AQ = Autism Spectrum Quotient; AS = Asperger Syndrome; ASD = Autism Spectrum Disorder; ASDS = Asperger Syndrome Diagnostic Scale; DSM-IV = Diagnostic & Statistical Manual of Mental Disorder (4<sup>th</sup> Edition); DSM-IV-TR = Diagnostic & Statistical Manual of Mental Disorder (4<sup>th</sup> Edition, Text Revision); HFA = High Functioning Autism; ICD-10 = International Classification of Diseases (10<sup>th</sup> Edition); LFA = Low Functioning Autism; PDD = Pervasive Developmental Disorder; PDD-NOS = Pervasive Developmental Disorder, Not Otherwise Specified; RRBIs = Restricted, Repetitive Behaviours & Interests; SCQ = Social Communication Questionnaire

## APPENDIX 2

Table 2.2. Measures and key findings of papers included in review in Chapter 2

Paper	Authors (date)	Outcome measures	Key findings
1	Baron-Cohen et al. (2014)	EQ SQ AQ	EQ: significant interaction between Sex and Diagnosis found smaller sex differences in ASD than TD group (F [df = 1, 4351] = 14, $p < .001$ , $\omega = .06$ ); ASC Female > ASC Male (F [df = 1, 4351] = 33.4, $p < .001$ , $d = .40$ ); TD Female > TD Male (F [df = 1, 4351] = 455, $p < .001$ , $d = .76$ ).  SQ: significant interaction between Sex and Diagnosis found smaller sex differences in ASD than TD group (F [df = 1, 4146] = 11.6, $p < .001$ , $\omega = .06$ ); ASD Male > ASC Female (F [df = 1, 4146] = 15.6, $p < .001$ , $d = .27$ ); TD Male > TD Female (F [df = 1, 4146] = 275.36, $p < .001$ , $d = .61$ ).  AQ: significant interaction between Sex and Diagnosis found smaller sex differences in ASD than TD group (F [df = 1, 4713] = 3.94, $p = .047$ , $\omega = .02$ ); ASD Male > ASC Female (F [df = 1, 4713] = 10.97, $p < .001$ , $d = .18$ ); TD Male > TD Female (F [df = 1, 4713] = 133, $p < .001$ , $d = .41$ ).
2	Baron-Cohen et al. (2003)	EQ SQ	EQ: no significant difference between ASD Female and ASD Male (t [df = 18.68] = 1.09, $p = .22$ ); TD Female > TD Male (F [df = 1, 269] = 38.6, $p < .001$ ).  SQ: no significant difference between ASD Female and ASD Male (t [df = 45] = -0.46, $p > .65$ ); TD Male > TD Female (F [df = 1, 270] = 18.1, $p < .001$ ).
3	Baron-Cohen & Wheelwright (2004)	FQ	FQ: no significant interaction between Sex and Diagnosis (F [df = 1, 139] = 3.5, $p = .06$ ); TD > ASD (F [df = 1, 139] = 51.6, $p < .001$ ); Female > Male (F [df = 1, 139] = 16.8, $p < .001$ ).



4	Baron-Cohen et al., (2001)	AQ	AQ: significant interaction between Sex and Diagnosis ( $F [df = 1, 228] = 6.01, p = .02$ ); no significant difference between ASD Female and ASD Male (statistical tests not reported); TD Male > TD Female ( $t = 2.56, p < .01$ ).
5	Bolte, Duketis, Poustka & Holtmann (2011)	WISC	WISC: no significant interaction between Sex and Diagnosis ( $F = 0.07, p = .79, \text{partial } \eta^2 = .00$ ).
		WCST	WCST: no significant interaction between Sex and Diagnosis ( $F = 0.09, p = .75, \text{partial } \eta^2 = .00$ ).
		ToH	ToH: no significant interaction between Sex and Diagnosis for number of moves ( $F = 2.22, p = .07, \text{partial } \eta^2 = .03$ ) or completion time ( $F = 0.00, p = .96, \text{partial } \eta^2 = .00$ ).
		TMT	
		EFT	TMT: significant interaction between Sex and Diagnosis ( $F = 3.91, p = .04, \text{partial } \eta^2 = .04$ ); ASD Females were faster than ASD Males (statistical tests not reported); TD Males were faster than TD Females (statistical tests not reported).
		BDT	BDT: significant interaction between Sex and Diagnosis ( $F = 5.56, p = .02, \text{partial } \eta^2 = .05$ ); ASD Males performed better than ASD Females (statistical tests not reported); TD Females performed better than TD Males (statistical tests not reported).
			EFT: no significant interaction between Sex and Diagnosis ( $F = 0.02, p = .88, \text{partial } \eta^2 = .00$ ).
6	Dean et al. (2014)	Friendships Survey	Friendships Survey: no significant interaction between Sex and Diagnosis for social preferences ( $F [df = 1, 96] = 1.09, p = .30, \omega^2 = 0.2$ ), social acceptance ( $F [df = 4, 95] = .41, p = .53, \omega^2 = 1.35$ ), or social connections ( $F [df = 3, 96] = 1.35, p = .25, \omega^2 = .01$ ).

7	Goddard, Dritschel & Howlin (2014)	WASI	WASI: no significant difference between ASD and TD scores ( $t = 0.12, p = .94$ ).
		BPVS	BPVS: no significant difference between ASD and TD scores ( $t = 1.3, p = .24$ ).
		AMCT	AMCT: significant interaction between Sex and Diagnosis ( $F [df = 1, 44] = 4.24, p = .045, \eta^2 = .09$ ); ASD Females produced more autobiographical memories than ASD Males (statistical tests not reported); no difference between TD Females and TD Males (statistical tests not reported).
		RRMT	RRMT: no significant interaction between Sex and Diagnosis (statistical tests not reported).
8	Harrop, Green & Hudry (2016)	Mullen ELC	Mullen: no significant difference between ASD Female and ASD Male ( $t [df = 26] = 9.15, p = .37$ ); no significant difference between ASD and TD scores ( $t [df = 3, 50] = 0.94, p = .96$ ).
		Toy Engagement	Toy Engagement: significant interaction between Sex and Diagnosis for garage and cars ( $F [df = 3, 50] = 20.21, p < .001$ ); TD Males played more than ASD Males ( $p = .04$ ), or TD Females and ASD Females ( $p < .001$ ); no significant interactions for other types of play.
9	Head, McGillivray & Stokes (2014)	FQ	FQ: no significant interaction between Sex and Diagnosis ( $F [df = 1, 101] = 1.00, p > .05, \eta^2 = .01$ ); ASD Females > ASD Males ( $t [df = 48] = -3.64, p < .05$ ).
10	Holt et al. (2014)	WASI	WASI: no significant difference between ASD Male and TD Male (statistical tests not reported); ASD Female < TD Female ( $p = .001$ ).
		RMET	RMET: ASD < TD ( $p = .002$ ); ASD Male < TD Male ( $F [df = 2, 61] = 3.39, p = .004$ ); no significant difference between ASD Female and TD Female ( $F [df = 2, 60] = 2.02, p = .141$ ); no significant interaction between Sex and Diagnosis (statistical tests not reported).

11	Kirkovski, Enticott, Hughes, Rossell & Fitzgerald (2016)	KBIT-2	KBIT-2: no significant difference between ASD and TD (statistical tests not reported).
		RAADS-R	RAADS-R: ASD > TD on all subscales (statistical tests not reported).
		EQ	EQ: ASD < TD (statistical tests not reported).
		AQ	AQ: ASD > TD (statistical tests not reported).
12	Knickmeyer, Wheelwright & Baron-Cohen (2008)	CPQ	CPQ: Sex-typical play shown by TD Females ( $t [df = 42] = 11.58, p < .001$ ), TD Males ( $t [df = 60] = 13.55, p < .001$ ) and ASD Males ( $t [df = 45] = 11.8, p < .001$ ); Sex-typical play not shown by ASD Females ( $t [df = 19] = 1.30, p = .21$ ).
13	Lai et al. (2012)	WASI	WASI: no significant difference between Female ASD, Male ASD, Female TD or Male TD groups (statistical tests not reported).
		Go/No-Go Task	Go/No-Go Task: no significant interaction between Sex and Diagnosis ( $F [df = 2, 120] = 0.173, p = .842$ , Pillai's Trace $V = .003$ ).
		EFT	EFT: marginally significant interaction between Sex and Diagnosis ( $F [df = 1, 122] = 137.40, p < .001$ ); ASD M < TD M ( $p = .001$ ); no significant difference between ASD F and TD M ( $p = .83$ ); no significant difference between ASD F and ASD M ( $p = .04$ ); TD M > TD F ( $p < .001$ ).
		RMET	
		KDEFT	
		NWRT	RMET: no significant interaction between Sex and Diagnosis ( $F [df = 1, 122] = 0.42, p = .521$ , partial $\eta^2 = .003$ ).
		KDEFT: no significant interaction between Sex and Diagnosis on any emotion (see paper for test results).	
		NWRT: no significant interaction between Sex and Diagnosis ( $F [df = 1, 122] = 0.23, p = .635$ , Pillai's Trace $V = .002$ ).	

14	Lemon, Gargaro, Enticott & Rinehart (2011)	WISC	WISC: no statistical tests reported.
		Stop Task	Stop Task: Significant effect of Group ( $F [df = 3, 19] = 3.87, p = .026$ ); ASD Females were slower than TD Females ( $p = .002, d = 1.30$ ) and TD Males ( $p = .025, d = 0.86$ ); no significant difference between ASD Males and TD Males ( $p = .919, d = 0.05$ ).
15	May, Cornish & Rinehart (2012)	SRS	SRS: no significant interaction between Sex and Diagnosis (statistical tests not reported); ASD Group > TD Group ( $F = 229.871, p < .001$ ); no sex differences ( $F = 0.996, p$ not reported).
		CCC	CCC: no significant interaction between Sex and Diagnosis (statistical tests not reported); ASD Group < TD Group on all subscales (see paper for test results); Males < Females for some subscales (see paper for test results).
		RBQ	
		WISC/WASI	RBQ: no significant interaction between Sex and Diagnosis (statistical tests not reported); ASD Group > TD Group ( $F = 85.397, p < .001$ ); Males > Females for one subscale (see paper for test results).
		SWAN	
		Conners 3	WISC/WASI Full-Scale IQ: TD Group > ASD Group ( $F = 7.716, p < .001$ ).
		Parent Short Form	
			SWAN: ASD Group > TD Group for hyperactivity ( $F = 60.08, p < .001$ ) and inattention ( $F = 83.08, p < .001$ ); Males > Females for hyperactivity ( $F = 4.51, p < .05$ ) and inattention ( $F = 4.28, p < .05$ ).
			Conners 3: significant interaction between Sex, Age and Diagnosis for hyperactivity ( $F [df = 1, 122] = 4.279, p = .041$ ); no sex differences for inattention ( $F = 2.981, p$ not reported); ASD Group > TD Group for inattention ( $F = 80.089, p < .001$ ).
16	Oswald et al. (2016)	KBIT-2	KBIT-2: no significant difference between ASD and TD scores ( $F < 0.01, p$ not reported).
		RCADS	

		MASC	RCADS: significant interaction between Sex, Diagnosis, and Developmental Stage ( $F [df = 2, 54] = 3.30, p = .04$ , partial $\eta^2 = 0.11$ ); ASD Female > ASD Male and TD Female in early adolescence but no difference between ASD Female and ASD Male by late adolescence (all $p$ 's < .01).
		CES-D	
			MASC: marginally significant interaction between Sex, Diagnosis, and Developmental Stage ( $F [df = 1, 55] = 3.79, p = .06$ , partial $\eta^2 = 0.06$ ); ASD Female > ASD Male and TD Female in early adolescence (all $p$ 's < .01).
			CES-D: marginally significant interaction between Sex, Diagnosis, and Developmental Stage ( $F [df = 4, 51] = 2.17, p = .09$ , partial $\eta^2 = 0.15$ ); ASD Female and TD Male > ASD Male and TD Female in early adolescence but ASD Female and Male > TD Female and Male by late adolescence (all $p$ 's < .05).
17	Park et al. (2012)	SCQ	SCQ: ASD Male > ASD Female ( $t = 2.27, p < .001$ ); no significant difference between TD Male and TD Female ( $t = 0.62, p = .54$ ).
		ASDS	
		ADI-R	ASDS: no significant difference between ASD Female and ASD Male on any subscale (see paper for test results); no significant difference between TD Female and TD Male on any subscale (see paper for test results).
		LIPS	
		CBC	ADI-R: ASD Male > ASD Female for communication impairments ( $t = 2.34, p = .028$ ) and repetitive, stereotyped behaviours ( $t = 2.03, p = .045$ ); no significant difference between TD Female and TD Male for any core autistic symptom (see paper for test results).
		AQ	
		EQ	LIPS: TD Group > ASC Group ( $F = 26.80, p < .001$ ).
		SQ	
			CBC: no significant difference between ASD Female and ASD Male on any subscale (see paper for test results); no significant difference between TD Female and TD Male on any subscale (see paper for test results).

AQ: ASD Male > ASD Female ( $t = 2.19, p = .031$ ); no significant difference between TD Male and TD Female ( $t = 1.76, p = .085$ ).

EQ: no significant difference between ASD Female and ASD Male ( $t = 0.53, p = .605$ ); no significant difference between TD Female and TD Male ( $t = 1.67, p = .104$ ).

SQ: no significant difference between ASD Female and ASD Male ( $t = 0.87, p = .388$ ); TD Male > TD Female ( $t = 2.52, p = .016$ ).

18	Sedgewick, Hill, Yates, Pickering & Pellicano (2015)	SRS WAIS FQS	<p>SRS: significant interaction between Sex and Diagnosis (<math>F [df = 1, 42] = 4.79, p = .03, \text{partial } \eta^2 = .10</math>); ASD Male &gt; ASD Female (<math>t [df = 21] = .242, p = .03, d = 1.03</math>); no significant difference between TD Male and TD Female (<math>t [df = 21] = .26, p = .12</math>).</p> <p>WAIS: no significant effect of Sex (<math>p &gt; .33</math>) or Diagnosis (<math>p &gt; .18</math>); no significant interaction between Sex and Diagnosis (<math>p &gt; .33</math>).</p> <p>FQS: significant interaction between Sex and Diagnosis for Help (<math>F [df = 1, 42] = 6.21, p = .01, \text{partial } \eta^2 = .13</math>) and Closeness (<math>F [df = 1, 42] = 6.26, p = .01, \text{partial } \eta^2 = .13</math>) subscales; no significant interactions found for other subscales (see paper for test results).</p>
19	Solomon et al. (2012)	SRS CCC RBS WASI BASC	<p>SRS: no significant difference between ASD Female and ASD Male on any subscale (statistical tests not reported); ASD Female &gt; TD Female on all subscales (statistical tests not reported); no difference between ASD Male and TD Male on any subscale (statistical tests not reported); no difference between TD Female and TD Male on any subscale (statistical tests not reported).</p> <p>CCC: no significant difference between ASD Female and ASD Male on any subscale (statistical tests not reported); TD Female &gt; ASD Female on all subscales (statistical tests not reported); TD Male &gt; ASD Male on</p>

all subscales (statistical tests not reported); no significant difference between TD Female and TD Male (statistical tests not reported).

RBQ: no significant difference between ASD Female and ASD Male on any subscale (statistical tests not reported); ASD Female > TD Female for all subscales but one (statistical tests not reported); ASD Male > TD Male for all subscales (statistical tests not reported); no significant difference between TD Female and TD Male (statistical tests not reported).

WASI: TD group > ASD group (statistical tests not reported).

BASC: no significant difference between ASD Female and ASD Male on any subscale (statistical tests not reported); ASD Female > TD Female on all subscales (statistical tests not reported); ASD Male > TD Male on depression only (statistical tests not reported); no significant difference between TD Female and TD Male (statistical tests not reported).

20	Zwaigenbaum et al. (2012)	ADI-R  Mullen ELC	ADI-R: no significant interaction between Sex and Diagnosis for any subscale (see paper for test results); Males > Females for communication ( $F = 19.5, p < .001$ ) and social impairments ( $F = 3.95, p = .049$ ); ASD Group > TD Group for all subscales (see paper for test results).  Mullen ELC: no significant interaction between Sex and Diagnosis for any subscale (see paper for test results).
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*Note.* Degrees of freedom (df) for tests are included where reported in original papers. ADI-R = Autism Diagnostic Interview – Revised; AMCT = Autobiographical Memory Cueing Task; AQ = Autism Quotient; ASD = Autism Spectrum Disorder; ASDS = Asperger Syndrome Diagnostic Scale; BASC = Behaviour Assessment System for Children; BDT = Block Design Test; BPVS = British Picture Vocabulary Scale; CBC = Child Behavioural Checklist; CCC = Children's Communication Checklist; CES-D = Centre for Epidemiological Studies Depression Scale; CPQ = Child Play Questionnaire; EFT = Embedded Figures Test; EQ = Empathising Quotient; FQ = Friendship Questionnaire; FQS = Friendship Qualities Scale; KBIT-2 = Kaufman Brief Intelligence Test – Second Edition; KDET = Karolinska Directed Emotional Faces Task; LIPS = Leiter International Performance Scale; MASC = Multidimensional Anxiety Scale for Children; Mullen ELC = Mullen Early Learning Composite; NWRT = Non-Word Repetition Task; RAADS-R = Ritvo Autism and Asperger's Diagnostic Scale—Revised; RBQ = Repetitive Behaviours Questionnaire; RBS = Repetitive Behaviours Scale; RCADS = Revised Child Anxiety & Depression Scale; RMET = Reading the Mind in the Eyes Task; RRMT = Recent & Remote Memory Task; SCQ = Social Communication Questionnaire; SQ = Systemising Quotient; SRS = Social Responsiveness Scale; SWAN = Strengths and Weaknesses in Attention-Deficit Hyperactivity Symptoms; TD = Typically Developing; ToH = Tower of Hanoi; TMT = Trail-Making Test; WASI = Wechsler Abbreviated Scale of Intelligence; WCST = Wisconsin Card Sort Test; WISC = Wechsler Intelligence Scales for Children.

## APPENDIX 3

Survey used to elicit responses for qualitative study of camouflaging experiences in autistic adults in Chapter 4

### Camouflaging Questionnaire

*NB: Closed questions have response options below.*

1. Have you ever had the experience of 'camouflaging' your autism? A reminder: in this survey we use the term 'camouflaging' to refer to 'coping skills, strategies, and techniques that function to "mask" features of ASC' during social situations.

Yes/No

2. In what situations do you camouflage (for example, when meeting new people, in large groups, job interviews etc.)?

3. How frequently do you camouflage in social situations? Please give more detail if you would like.

Always (camouflage in almost all social situations [>95%])

Often (camouflage in most social situations [>50%])

Sometimes (occasionally camouflage in social situations [<50%])

Never (do not camouflage in social situations [0%])

None of the above (please describe)

4. In social situations, how do you camouflage/what do you do when you camouflage? Please provide details and examples, for instance the behaviours and thoughts you experience.

Note: we would like you to share your own personal experiences about what you do, without presuming what these might be, so we have not listed any examples of common behaviours here. However, the next section of questions will ask you directly about examples we know from others' experiences to date.



Some people with ASC have reported the following as examples of camouflaging/coping in social situations. We would be interested to know if you have ever:

*Responses for questions 5-22:*

Always   Often   Sometimes   Never

5.      Tried to hide difficulties with eye contact by pretending that you are making eye contact?
6.      Tried to hide your social stress by pretending that you are relaxed?
7.      Tried to use learned/pre-prepared jokes or one-liners in conversation?
8.      Tried to keep conversation flowing by talking about your special interests?
9.      Tried to make your movements more natural by deliberately practicing them when alone?
10.     Tried to copy other people's body language?
11.     Practiced how to make the intonation of your voice sound more 'normal', by speaking aloud to yourself when you are alone?
12.     Practiced facial expressions in front of the mirror when you are alone?
13.     Tried to learn to use gestures to blend in amongst neurotypicals?
14.     Pretended to be interested in topics during conversation with others, just to fit in?
15.     Engaged in other (non-social) activities (e.g. studying objects in the situation, cleaning, using smartphone/tablet) in social situations?
16.     Forced yourself to approach strangers to increase your confidence in social interaction?
17.     Studied people's behaviour in films by playing certain clips over and over again, and then tried to imitate these?
18.     Observed one particular person in your class (when you were a student), workplace, or neighbourhood, who was socially successful, and tried to copy his/her mannerisms, talking style, dress style etc.?

19. Consciously acted in social situations?
20. Conducted 'research' (e.g. reading novels, learning about psychology) to work out the rules of human behaviour?
21. Tried to create rules to guide you through a social interaction?
- 21a. Please tell us your rules:
22. Tried to develop rules that you follow to keep conversation going, such as 'talk a lot', 'tell the listener an anecdote about something that happened', 'keep talking so that the conversation doesn't dry up' etc.?
- 22a. Please tell use your rules for keeping conversation going (for example, thinking about how best to imitate neurotypical people):
23. In these behaviours and thoughts that you have when you camouflage, which ones do you need to 'perform' / 'act' with effort?
24. In these behaviours and thoughts that you have when you camouflage, which ones are more 'intuitive' / 'automatic'?
25. Why do you camouflage during social situations?
26. To what degree do you think camouflaging is necessary for you in social situations?
27. How do you know if your camouflaging works or not?
28. How successful do you think your camouflaging is? Please give more detail if you would like.

1 (not good at all)

2 (fair)

3 (mostly good)

4 (very good)

X (unsure/not known)

29. Has anyone told you that they have noticed that you are camouflaging?

Yes/No

29a. How did they recognise that you were camouflaging?

30. How do you feel after camouflaging?

31. When you get home after a day of work/school, or an episode of 'pretending' to be neurotypical, do you feel exhausted and in need of isolation?

Yes/No

32. At what age did you consciously start to camouflage in social situations?

33. What are the skills that are needed for successful camouflaging?

34. How did you learn to camouflage?

35. What are the negative consequences of camouflaging for you?

36. What are the positive consequences of camouflaging for you?

37. Have you ever decided not to camouflage in social situations? Why?

38. Do you think support programs for individuals with an ASC should cover the topic of camouflaging (for example, when and how to do it, knowing its consequences)? Why?

39. Do you think people working with individuals with an ASC (for example, employers, clinicians, teachers etc.) should be knowledgeable about, and be able to identify, camouflaging? Why?

40. Do you think 'camouflaging' is the right word to describe what you may do in social situations? If not, what do you think is a better term to call it? Why?

## APPENDIX 4

### Camouflaging Autistic Traits Questionnaire (CAT-Q)

Please read each statement below and choose the answer that best fits your experiences during social interactions.

Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agree (6)	Strongly Agree (7)
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1. When I am interacting with someone, I deliberately copy their body language or facial expressions
2. I monitor my body language or facial expressions so that I appear relaxed
3. I rarely feel the need to put on an act in order to get through a social situation\*
4. I have developed a script to follow in social situations (for example, a list of questions or topics of conversation)
5. I will repeat phrases that I have heard others say in the exact same way that I first heard them
6. I adjust my body language or facial expressions so that I appear interested by the person I am interacting with
7. In social situations, I feel like I'm 'performing' rather than being myself
8. In my own social interactions, I use behaviours that I have learned from watching other people interacting
9. I always think about the impression I make on other people
10. I need the support of other people in order to socialise
11. I practice my facial expressions and body language to make sure they look natural
12. I don't feel the need to make eye contact with other people if I don't want to\*

13. I have to force myself to interact with people when I am in social situations
14. I have tried to improve my understanding of social skills by watching other people
15. I monitor my body language or facial expressions so that I appear interested by the person I am interacting with
16. When in social situations, I try to find ways to avoid interacting with others
17. I have researched the rules of social interactions (for example, by studying psychology or reading books on human behaviour) to improve my own social skills
18. I am always aware of the impression I make on other people
19. I feel free to be myself when I am with other people\*
20. I learn how people use their bodies and faces to interact by watching television or films, or by reading fiction
21. I adjust my body language or facial expressions so that I appear relaxed
22. When talking to other people, I feel like the conversation flows naturally\*
23. I have spent time learning social skills from television shows and films, and try to use these in my interactions
24. In social interactions, I do not pay attention to what my face or body are doing\*
25. In social situations, I feel like I am pretending to be 'normal'

**Scoring:**

All items are scored 1-7, with higher scores reflecting greater camouflaging. Items with an asterisk (\*) should be reverse scored.

**Factors:**

Compensation = 1, 4, 5, 8, 11, 14, 17, 20, 23

Masking = 2, 6, 9, 12, 15, 18, 21, 24

Assimilation = 3, 7, 10, 13, 16, 19, 22, 25

## APPENDIX 5

Figure 5.2. Distribution of Camouflaging subscale scores in male and female autistic and non-autistic subsamples.

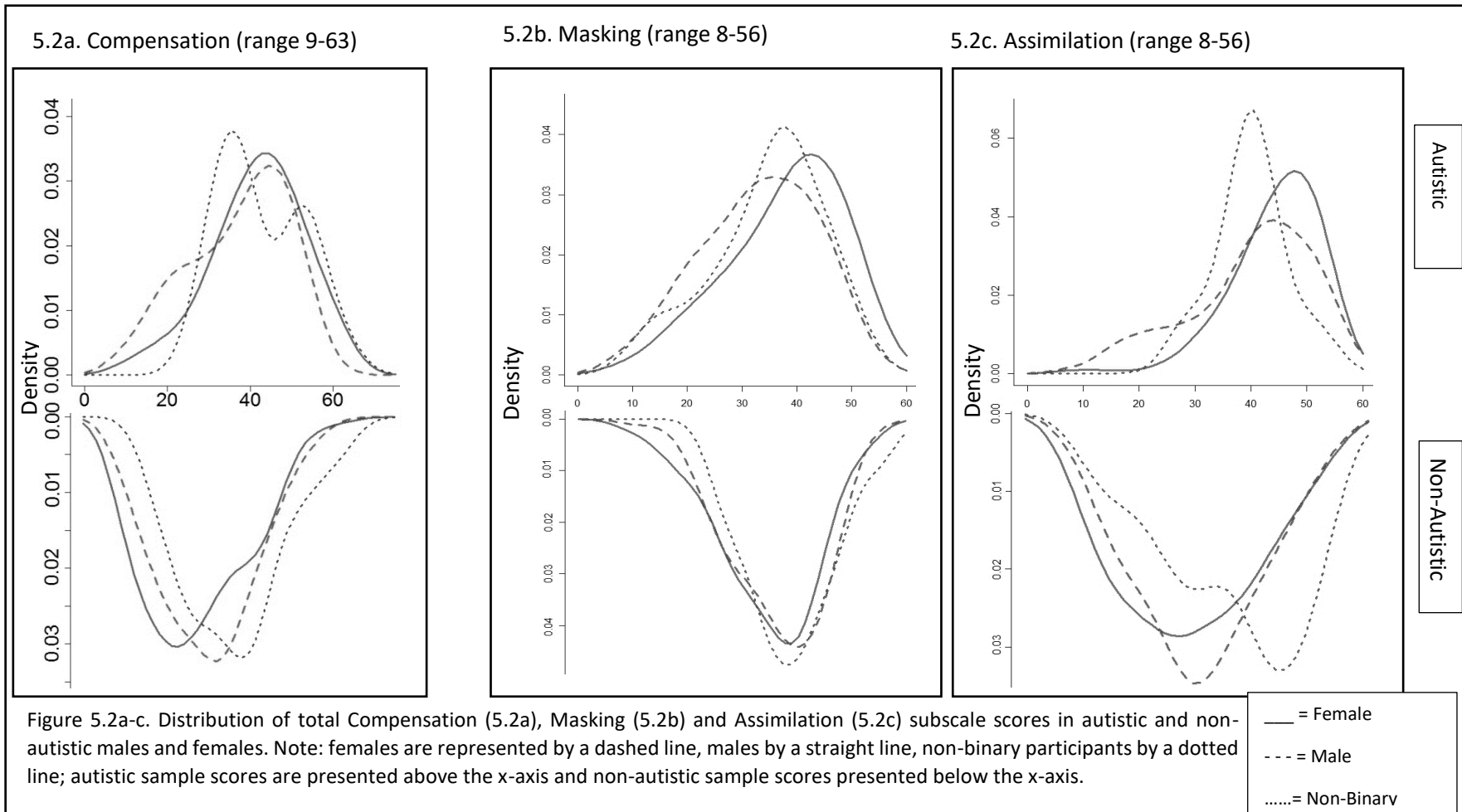


Figure 5.2a-c. Distribution of total Compensation (5.2a), Masking (5.2b) and Assimilation (5.2c) subscale scores in autistic and non-autistic males and females. Note: females are represented by a dashed line, males by a straight line, non-binary participants by a dotted line; autistic sample scores are presented above the x-axis and non-autistic sample scores presented below the x-axis.

## APPENDIX 6

### Parent-Report Questionnaire of Camouflaging Autistic Traits

Please read each statement below and choose the answer that best fits your perception of your child's experiences during social interactions.

Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agree (6)	Strongly Agree (7)
-----------------------------	-----------------	-----------------------------	-----------------------------------------	--------------------------	--------------	--------------------------

1. When my child is interacting with someone, they deliberately copy the other person's body language or facial expressions
2. My child monitors their body language or facial expressions so that they appear relaxed
3. My child rarely feels the need to put on an act in order to get through a social situation\*
4. My child has developed a script to follow in social situations (for example, a list of questions or topics of conversation)
5. My child will repeat phrases that they have heard others say in the exact same way that they first heard them
6. My child adjusts their body language or facial expressions so that they appear interested by the person they are interacting with
7. In social situations, my child is 'performing' rather than being themselves
8. In my child's social interactions, they use behaviours that they have learned from watching other people interacting
9. My child always thinks about the impression they make on other people
10. My child needs the support of other people in order to socialise
11. My child practices their facial expressions and body language to make sure they look natural

12. My child doesn't feel the need to make eye contact with other people if they don't want to\*
13. My child has to force themselves to interact with people when they are in social situations
14. My child has tried to improve their understanding of social skills by watching other people
15. My child monitors their body language or facial expressions so that they appear interested by the person they are interacting with
16. When in social situations, my child tries to find ways to avoid interacting with others
17. My child has researched the rules of social interactions (for example, by studying psychology or reading books on human behaviour) to improve their own social skills
18. My child is always aware of the impression they make on other people
19. My child feels free to be themselves when they are with other people\*
20. My child learns how people use their bodies and faces to interact by watching television or films, or by reading fiction
21. My child adjusts their body language or facial expressions so that they appear relaxed
22. When my child is talking to other people, the conversation flows naturally\*
23. My child has spent time learning social skills from television shows and films, and tries to use these in their interactions
24. In social interactions, my child does not pay attention to what their face or body are doing\*
25. In social situations, my child feels like they are pretending to be 'normal'
- 26.

**Scoring:**

All items are scored 1-7, with higher scores reflecting greater camouflaging. Items with an asterisk (\*) should be reverse scored.



**Factors:**

Compensation = 1, 4, 5, 8, 11, 14, 17, 20, 23

Masking = 2, 6, 9, 12, 15, 18, 21, 24

Assimilation = 3, 7, 10, 13, 16, 19, 22, 25

## APPENDIX 7

### Social Impressions Task

Now I would like you to spend a couple of minutes telling me about your last holiday. I will try not to talk too much, unless you would like me to ask questions. While you are doing this, I would like you to try and be **your best social self**, and **make a really good impression** for the camera.

Here are some things you could talk about:

1. Where did you go?
2. How long did you go for?
3. Who did you go with?
4. What was your favourite thing that you did on holiday?
5. What did you like the least about going on holiday?

When finished [stop recording].

## APPENDIX 8

### Social Impressions rating form

Please rate how much you agree with each of the following statements (0 = do not agree at all, 3 = agree completely)

0

1

2

3

I think the  
person is  
engaging

I think the  
person is  
awkward

I think the  
person is  
intelligent

I think the  
person is  
likeable

I think the  
person is  
trustworthy

I think the  
person is  
dominant (low  
score = I think  
the person is  
submissive)

I would be  
willing to live  
near the person

I would be likely  
to hang out with

the person in  
my free time

0

1

2

3

I would be  
comfortable  
sitting next to  
the person

I would be likely  
to start a  
conversation  
with the person

## APPENDIX 9

Table 7.4. Self-reported Camouflaging: Predictors of Total CATQ and Compensation, Masking, and Assimilation subscales

Total CATQ score				
Female subsample				
R <sup>2</sup> Adj = 0.17, F(5,12) = 1.68, p = .22				
	B	β	P	95% CI
Intercept	109.53		.45	-193.07 – 412.13
Age	4.43	0.20	.45	-8.03 – 16.88
IQ	0.91	0.45	.24	-0.69 – 2.51
BRIEF-2	-0.99	-0.40	.21	-2.65 – 0.66
ToM	-4.94	-0.43	.28	-14.54 – 4.65
FQ	-0.31	-0.23	.36	-0.99 – 0.39
Male subsample				
R <sup>2</sup> Adj = 0.18, F(5,8) = 1.57, p = .27				
	B	β	P	95% CI
Intercept	259.02		.04	22.83 – 495.20
Age	-6.84	-0.36	.24	-19.13 – 5.45
IQ	0.09	0.06	.83	-0.87 – 1.06
<b>BRIEF-2</b>	<b>-1.32</b>	<b>-0.69</b>	<b>.03</b>	<b>-2.54 – -0.16</b>
ToM	-1.72	-0.15	.63	-9.65 – 6.21
FQ	0.66	0.37	.27	-0.62 – 1.94

Table 7.4 continued

**Compensation subscale score**

Female subsample				
R <sup>2</sup> Adj = 0.01, F(5,12) = 1,95, p = .43				
	B	β	P	95% CI
Intercept	40.71		.56	-107.48 – 189.90
Age	1.04	0.11	.72	-5.06 – 7.14
IQ	0.26	0.28	.49	-0.53 – 1.04
BRIEF-2	-0.38	-0.34	.33	-1.19 – 0.43
ToM	-0.60	-0.12	.79	-5.30 – 4.10
FQ	-0.11	-0.18	.49	-0.45 – 0.23
Male subsample				
R <sup>2</sup> Adj = 0.06, F(5,8) = 1.17, p = .40				
	B	β	P	95% CI
Intercept	79.97		.16	-37.77 – 197.71
Age	-2.03	-0.23	.47	-8.16 – 4.09
IQ	0.16	0.22	.45	-0.32 – 0.64
BRIEF-2	-0.50	-0.55	.09	-1.09 – 0.09
ToM	-2.06	-0.38	.26	-6.01 – 1.89
FQ	0.40	0.48	.19	-0.24 – 1.04

Table 7.4 continued

**Masking subscale score**

Female subsample				
R <sup>2</sup> Adj = 0.35, F(5,12) = 2.86, p = .06				
	B	$\beta$	P	95% CI
Intercept	14.12		.79	-98.60 – 126.84
Age	0.43	0.05	.84	-4.21 – 5.07
<b>IQ</b>	<b>0.73</b>	<b>0.85</b>	<b>.02</b>	<b>0.13 – 1.32</b>
BRIEF-2	-0.35	-0.33	.24	-0.97 – 0.26
<b>ToM</b>	<b>-3.65</b>	<b>-0.75</b>	<b>.045</b>	<b>-7.23 – -0.08</b>
FQ	0.16	0.29	.20	-0.10 – 0.42
Male subsample				
R <sup>2</sup> Adj = 0.23, F(5,8) = 1.76, p = .23				
	B	$\beta$	P	95% CI
Intercept	64.60		.09	-12.82 – 14.01
Age	0.71	0.11	.69	-3.32 – 4.74
IQ	-0.12	-0.22	.42	-0.43 – 0.20
<b>BRIEF-2</b>	<b>-0.44</b>	<b>-0.67</b>	<b>.03</b>	<b>-0.83 – -0.06</b>
ToM	-0.77	-0.19	.52	-3.36 – 1.83
FQ	0.19	0.32	.33	-0.23 – 0.61

Table 7.4 continued

**Assimilation subscale score**

Female subsample				
R <sup>2</sup> Adj = 0.55, F(5,12) = 5.19, p = .01				
	B	$\beta$	P	95% CI
Intercept	2.36		.95	-80.20 – 85.02
Age	3.28	0.40	.06	-0.13 – 6.68
IQ	0.10	0.14	.61	-0.33 – 0.54
BRIEF-2	-0.03	-0.04	.88	-0.48 – 0.42
ToM	0.14	0.03	.91	-2.48 – 2.76
<b>FQ</b>	<b>-0.30</b>	<b>-0.61</b>	<b>.004</b>	<b>-0.49 – -0.11</b>
Male subsample				
R <sup>2</sup> Adj = 0.13, F(5,8) = 1.39, p = .32				
	B	$\beta$	P	95% CI
Intercept	97.03		.07	-9.33 – 203.38
Age	-4.69	-0.57	.09	-10.22 – 0.84
IQ	0.09	0.13	.63	-0.34 – 0.53
BRIEF-2	-0.31	-0.36	.21	-0.85 – 0.22
ToM	0.84	0.16	.60	-2.73 – 4.41
FQ	0.02	0.02	.95	-0.56 – 0.59

Note. BRIEF-2 = Behaviour Rating Inventory of Executive Function, 2<sup>nd</sup> Edition; ToM = Strange Stories test of Theory of Mind; FQ = Friendship Questionnaire.



## APPENDIX 10

Table 7.5. Parent-reported Camouflaging: Predictors of Total CATQ and Compensation, Masking, and Assimilation subscales

<b>Total CATQ score</b>				
Female subsample				
R <sup>2</sup> Adj = 0.17, F(5,11) = 1648, p = .23				
	B	β	P	95% CI
Intercept	12.76		.92	-257.16 – 282.68
Age	0.53	0.03	.91	-10.05 – 11.12
IQ	1.18	0.73	.11	-0.31 – 2.67
BRIEF-2	-0.22	-0.10	.75	-1.69 – 1.25
ToM	-2.23	-0.23	.58	-10.92 – 6.45
FQ	0.18	0.17	.50	-0.40 – 0.76
Male subsample				
R <sup>2</sup> Adj = -0.21 F(5,8) = 0.55, p = .73				
	B	β	P	95% CI
Intercept	176.52		.15	-80.80 – 433.84
Age	-4.67	-0.27	.45	-18.06 – 8.72
IQ	-0.03	-0.02	.95	-1.08 – 1.02
BRIEF-2	-0.70	-0.40	.25	-1.99 – 0.59
ToM	1.62	0.15	.68	-7.02 – 10.26
FQ	0.37	0.23	.56	-1.02 – 1.76

Table 7.5 continued

**Compensation subscale score**

Female subsample				
R <sup>2</sup> Adj = -0.06, F(5,10) = 0.83, p = .56				
	B	$\beta$	P	95% CI
Intercept	70.86		.28	-66.64 – 208.37
Age	-2.29	-0.29	.37	-7.68 – 3.11
IQ	0.20	0.27	.58	-0.56 – 0.95
BRIEF-2	-0.22	0.27	.58	-0.97 – 0.95
ToM	-0.22	0.02	.97	-4.35 – 4.50
FQ	-0.03	-0.06	.84	-0.32 – 0.27
Male subsample				
R <sup>2</sup> Adj = -0.10, F(5,8) = 0.76, p = .60				
	B	$\beta$	P	95% CI
Intercept	73.81		.16	-34.91 – 182.52
Age	-3.68	-0.49	.17	-9.34 – 1.97
IQ	0.06	0.09	.78	-0.39 – 0.50
BRIEF-2	-0.10	-0.12	.70	-0.64 – 0.45
ToM	-1.03	-0.22	.53	-4.68 – 2.62
FQ	0.44	0.62	.12	-0.15 -1.03

Table 7.5 continued

**Masking subscale score**

Female subsample				
$R^2 \text{ Adj} = 0.21, F(5,10) = 1.86, p = .18$				
	B	$\beta$	P	95% CI
Intercept	-54.37		.35	-176.20 – 67.46
Age	1.94	0.24	.39	-2.84 – 6.72
IQ	0.61	0.82	.07	-0.06 – 1.20
BRIEF-2	-0.02	-0.02	.95	-0.68 – 0.64
ToM	-1.83	-0.41	.33	-5.75 – 2.09
FQ	0.23	0.46	.08	-0.04 – 0.49
Male subsample				
$R^2 \text{ Adj} = -0.05, F(5,8) = 0.88, p = .54$				
	B	$\beta$	P	95% CI
Intercept	52.32		.33	-63.63 – 168.27
Age	0.58	0.07	.83	-5.45 – 6.61
IQ	-0.13	-0.18	.55	-0.60 – 0.34
BRIEF-2	-0.44	-0.51	.12	-1.02 – 0.15
ToM	1.54	0.30	.39	-2.36 – 5.43
FQ	-0.10	-0.14	.71	-0.73 – 0.52

Table 7.5 continued

**Assimilation subscale score**

Female subsample				
R <sup>2</sup> Adj = 0.15, F(5,11) = 1589 p = .25				
	B	$\beta$	P	95% CI
Intercept	-7.05		.84	-80.52 – 66.43
Age	1.25	-.27	.36	-1.63 – 4.13
IQ	0.25	0.80	.09	-0.06 – 0.75
BRIEF-2	0.02	0.04	.89	-0.37 – 0.42
ToM	-0.75	-0.29	.50	-3.12 – 1.61
FQ	-0.02	-0.08	.75	-0.18 – 0.13
Male subsample				
R <sup>2</sup> Adj = -0.04, F(5,8) = 0.90, p = .53				
	B	$\beta$	P	95% CI
Intercept	35.69		.25	-30.62 – 101.99
Age	-1.16	-0.25	.46	-4.61 – 2.29
IQ	0.06	0.15	.61	-0.21 – 0.33
BRIEF-2	-0.12	-0.24	.44	-0.45 – 0.21
ToM	1.28	0.44	.22	-0.04 – 3.51
FQ	-0.17	-0.04	.92	-0.38 – 0.34

Note. BRIEF-2 = Behaviour Rating Inventory of Executive Function, 2<sup>nd</sup> Edition; ToM = Strange Stories test of Theory of Mind; FQ = Friendship Questionnaire.

## APPENDIX 11

Published, peer reviewed articles

*Review Article*

### **Behavioural and cognitive sex/gender differences in Autism Spectrum Condition and typically developing males and females**

**Authors:**

Laura Hull<sup>1</sup>, William Mandy<sup>1</sup>, and K. V. Petrides<sup>1,2</sup>

<sup>1</sup> Research Department of Clinical, Educational & Health Psychology, University College  
London

<sup>2</sup> London Psychometric Laboratory, University College London

**Corresponding author:**

Laura Hull, Research Department of Clinical, Educational & Health Psychology, University  
College London, 26 Bedford Way, London, WC1E 6BT, UK.

Email: [laura.hull.14@ucl.ac.uk](mailto:laura.hull.14@ucl.ac.uk)

## **Behavioural and cognitive sex/gender differences in Autism Spectrum**

### **Conditions and typically developing males and females**

#### **Abstract**

Studies assessing sex/gender differences in autism spectrum conditions (ASC) often fail to include typically developing control groups. It is therefore unclear whether observed sex/gender differences reflect those found in the general population, or are particular to ASC. A systematic search identified papers comparing behavioural and cognitive characteristics in males and females with and without an ASC diagnosis. Thirteen studies were included in meta-analyses of sex/gender differences in core ASC symptoms (social/communication impairments and restrictive/repetitive behaviours & interests) and IQ. Twenty studies were included in a qualitative review of sex/gender differences in additional ASC symptoms. For core traits and IQ, sex/gender differences were comparable in ASC and typical samples. Some additional ASC symptoms displayed different patterns of sex/gender differences in ASC and typically developing groups, including measures of executive function, empathising and systemising traits, internalising and externalising problems, and play behaviours. Individuals with ASC display typical sex/gender differences in core ASC traits, suggesting that diagnostic criteria based on these symptoms should take into account typical sex/gender differences. However, awareness of associated ASC symptoms should include the possibility of different male and female phenotypes, to ensure those who do not fit the 'typical' ASC presentation are not missed.

#### **Keywords**

Autism Spectrum Conditions, sex differences, gender differences, diagnosis

## Introduction

Autism Spectrum Conditions (ASC) are more commonly diagnosed in males than in females across age groups (Fombonne, 2009; Russell, Steer, & Golding, 2011)<sup>1</sup>. Reliable genetic and/or physiological markers of ASC have not yet been identified, therefore diagnostic criteria rely on behavioural descriptions of the disorder. These criteria have been developed based on the predominantly male populations previously diagnosed or identified as having ASC (Kirkovski, Enticott, & Fitzgerald, 2013; Kopp & Gillberg, 2011; Mattila et al., 2011). However, researchers are increasingly focused on the experiences and characteristics of females with autism to determine whether males and females with ASC display similar behavioural and cognitive profiles (Dworzynski, Ronald, Bolton, & Happé, 2012; Gould & Ashton-Smith, 2011; Kopp & Gillberg, 1992; Lehnhardt et al., 2015; Mandy et al., 2012; Thompson, Caruso, & Ellerbeck, 2003; Werling & Geschwind, 2013). If females with ASC tend to demonstrate different symptom patterns to the majority of ASC males, they may be at greater risk of being missed by clinical services and support options than males (Dworzynski et al., 2012). It is, therefore, important to assess whether there is a need for a broader conceptualisation of ASC to include typically female patterns of this condition. If so, this could have implications for the diagnostic criteria of ASC.

There have been several reviews of the literature on sex/gender differences in the ASC core symptoms of social/communication impairments and restricted/repetitive behaviours and interests (RRBIs) [Note: following Lai, Lombardo, Auyeung, Chakrabarti, & Baron-Cohen (2015), we use the term 'sex/gender' to reflect the awareness that the effects of biological 'sex' and socially constructed 'gender' cannot be easily separated, and that most individuals' identities are informed by both sex and gender]. These generally conclude that females with ASC may display a different phenotype, or different patterns of ASC characteristics, to males with ASC (Kirkovski et al., 2013; van Wijngaarden-Cremers et al.,

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2014). While specific sex/gender differences in the severity of social and communication impairments have not been conclusively demonstrated (Koenig & Tsatsanis, 2005; Lai et al., 2011, 2012; Lai, Lombardo, Auyeung, Chakrabarti, & Baron-Cohen, 2015; Van Wijngaarden-Cremers et al., 2014), some have found that girls and women with ASC, on average, display fewer RRBI (Koenig & Tsatsanis, 2005; Kreiser & White, 2014; Rivet & Matson, 2011). However, it has been argued that RRBI diagnostic criteria fail to reflect the true range of areas under which RBIs can fall (Mandy et al., 2012). It is possible that many females with ASC experience very extreme interests or behavioural tendencies, but in areas outside the 'typical' ASC interests of systems and machines, therefore excluding them from meeting diagnostic criteria for RBIs in ASC.

Reviews have also addressed sex/gender differences in additional symptoms associated with ASC, such as internalising and externalising problems and the co-diagnoses that may result from these. Males with ASC and typically developing males with high autism traits are more likely to experience externalising problems such as behavioural problems and hyperactivity, while females are more likely to experience internalising problems such as depression and anxiety hyperactivity (Koenig & Tsatsanis, 2005; Kreiser & White, 2014; Rivet & Matson, 2011). This suggests that the pattern of behaviours associated with ASC symptoms varies between males and females, which may require adjustment of current diagnostic criteria.

In addition to sex/gender differences in ASC symptoms, differences in the diagnostic experiences of males and females with ASC have also been observed. Females with similar levels of ASC symptoms are less likely to be diagnosed with ASC than males (Dworzynski et al., 2012), and it is suggested that females are more likely to be misdiagnosed with other conditions, especially internalising and eating disorders (Kopp & Gillberg, 1992; Mandy & Tchanturia, 2015). Females who do receive an ASC diagnosis do so at a later age than males



on average (Kirkovski et al., 2013). A difference in the ASC symptoms experienced by males and females may partly account for this variation in diagnosis, as the female phenotype may not be viewed as 'typical' ASC symptoms, and so may not immediately point towards an ASC diagnosis.

Reviews have also emphasised that sex/gender differences in ASC are influenced by individual differences. Females with low IQ are more likely to receive a diagnosis than females with high IQ (Rivet & Matson, 2011; van Wijngaarden-Cremers et al., 2014), suggesting that there are additional factors interacting with sex/gender to produce differences in diagnostic rates. Individuals' ages were also found to influence sex/gender differences in core ASC symptoms; for instance, van Wijngaarden-Cremers et al. (2014) found that sex differences in RRBI only occur from the age of 6 years. There are also likely to be interacting influences from both social and biological factors, such as genetic influences and social/cultural environment, which will contribute to different developmental outcomes for males and females with ASC (Kreiser & White, 2014; Lai et al., 2015). It is, therefore, concluded that future research into sex/gender differences in ASC needs to take into account IQ, age, and other characteristics in order to fully understand how males and females with ASC develop.

Based on the above, males and females with ASC appear to demonstrate somewhat different characteristics, and have different clinical and diagnostic experiences. This would suggest that ASC diagnostic criteria and thresholds should vary for males and females, to ensure that all individuals are able to access the services and support they require. However, the precise ways in which diagnostic criteria might be adapted depend on exactly how and why males and females with ASC differ. One issue with previous research into sex/gender differences in ASC is that typical sex/gender differences have rarely been taken into account. This means that we cannot be certain whether males and females with ASC differ in the same

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ways that typically developing males and females differ, or whether having ASC has a differential impact on males and females, and it is this that produces the sex/gender differences described above.

If the first prediction is borne out, then the performance of ASC males and females on diagnostic criteria should also be compared to that of typically developing males and females respectively. Sex/gender differences (or lack thereof) in typically developing populations have been established for a wide range of behaviours related to ASC, therefore it stands to reason that ASC males should be compared to typically developing males, and ASC females to typically developing females when assessing strengths and impairments.

If, on the other hand, ASC does produce different outcomes for males and females beyond those attributed to typical sex/gender differences, adjustments to diagnostic criteria are less straightforward. One outcome might be the development of separate diagnostic criteria for males and females, reflecting differential presentations of ASC in each sex/gender in at least some areas. It has also been suggested that females with ASC may compensate for or mask their ASC-related behaviours to a greater extent than males with ASC, resulting in underestimations of the true extent of ASC and its symptomatology in females (Dworzynski et al., 2012; Lai et al., 2012). Including these behaviours in a female phenotype of ASC would increase identification of females and enable them to access the services and support they need.

Thus, it is important to compare sex/gender differences in the ASC population with those in typically developing groups, in order to establish whether ASC interacts with an individual's sex/gender to produce different outcomes, or whether typical sex/gender differences also exist within in the ASC population. This then has implications for adjustments to diagnostic criteria, and for a broader conceptualisation of ASC in males and females.

This research therefore aims to address the following questions:

What are the sex/gender differences in ASC core and associated symptoms (if any), for ASC and typically developing groups?

Do these sex/gender differences vary between ASC and typically developing groups? In other words, is there an interaction between sex/gender and ASC diagnosis?

## **Methods**

### **Literature Review**

A search of the Psych Info, Pub Med, and Web of Science directories in September 2015 for the terms “autism + sex differences” and “autism + gender differences” produced 3290 initial results. Figure 1 describes the logic used to select studies for inclusion. Eligibility criteria were peer-reviewed papers published in English and comparing males and females with and without an ASC diagnosis, which matched ASC and typically developing groups for IQ and age. Bibliographies of relevant papers, including those of seven recent review and/or meta-analysis papers, were manually searched to find additional papers which may have been missed in the initial search ( $n = 37$ ). Studies were excluded ( $n = 3307$ ) if they were duplicates, if they only measured biological sex/gender differences, and if they did not include groups of males and females with and without an ASC diagnosis, matched on age and IQ. Twenty original studies were selected for inclusion in the review of variation in sex/gender differences between ASC and typically developing groups. See Tables 1 and 2 for information about all 20 studies, including summaries of their findings and characteristics of the samples used. Where multiple comparison groups were included, the group most similar to an unrelated, general population sample was selected for inclusion in this review. Several additional authors were contacted to request data on control groups for inclusion in the analysis, but none were able to provide complete datasets. Due to the limited number of

eligible studies, meta-analysis of ASC and typical sex/gender differences was only possible for six studies measuring social/communication impairments, five studies measuring RRBI, and 13 studies measuring IQ.

Figure 1  
*PRISMA flow diagram of study identification and selection*

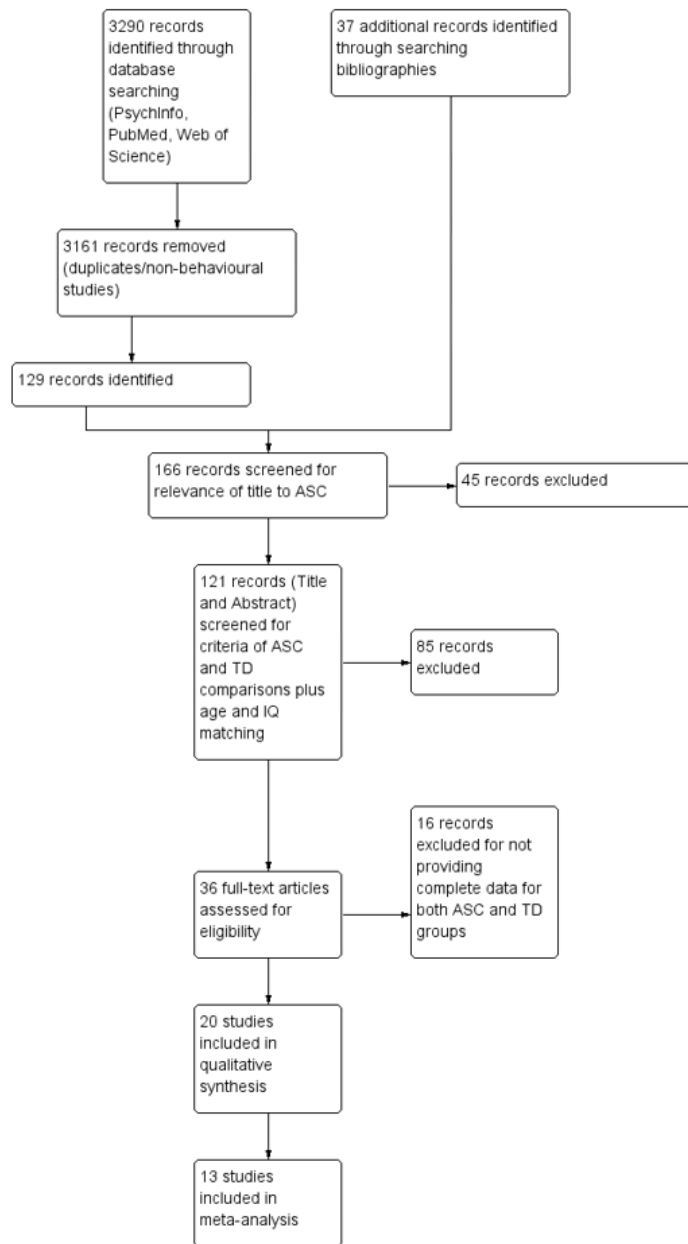


Figure 1. Flow diagram showing identification and selection of studies for inclusion in the review and meta-analysis. ASC = Autism Spectrum Conditions; TD = typically developing

### Statistical Analysis

Random-effects meta-analyses were performed using the 'metafor' package in R (R Core Team, 2013; Viechtbauer, 2010) for measures of the core ASC symptoms and IQ. Using a random-effects model accounts for variance between studies caused by sampling error and other artifacts (Hunter & Schmidt, 2004). Mean sex/gender differences in Social/Communication impairments (see Table 3), Restrictive/Repetitive Behaviours and Interests (see Table 4), and IQ (see Table 5) were calculated for ASD and TD groups, then standardised mean differences (SMD) between these differences were calculated, to take into account the variety of test instruments used. Social and communication impairments were analysed separately due to some studies testing these separately or only testing one of these, but are presented and discussed together, to reflect the fact that these autistic symptoms are treated as a unitary domain in DSM-5. Where tests for heterogeneity were significant, a mixed-effects model was used to test for the effect of the moderator 'Age' (Age of participants). ASC groups were entered into the analysis first, therefore positive effect sizes would mean greater sex/gender differences in ASC groups than typical groups, and negative effects sizes would mean smaller sex/gender differences in ASC groups. Where multiple measures of the same symptom were used within one study, the measure most similar to those used in other studies was selected for inclusion in this analysis. R script for all analyses is available on request from the first author.

## Results

### Meta-Analysis

Figure 2 presents the funnel plots for each of the four meta-analyses conducted. Due to the limited number of studies, it is difficult to draw conclusions about publication bias. However, three of the four plots show some asymmetry, with a positive skew, suggesting there may have been some publication bias in favour of studies reporting statistically significant sex/gender differences in ASC populations. Despite this, Hunter and Schmidt (2004) note that studies of sex/gender difference may be less susceptible to availability bias (the suggestion that studies with significant findings and large effect sizes are more likely to be published, and therefore more available for inclusion in meta-analyses) than other studies. This is because the sex/gender difference is usually a supplementary analysis to the research question of interest and so publication is less likely to be dependent on satisfactory sex/gender difference results.

Figure 2  
*Funnel plots of studies included in meta-analysis*

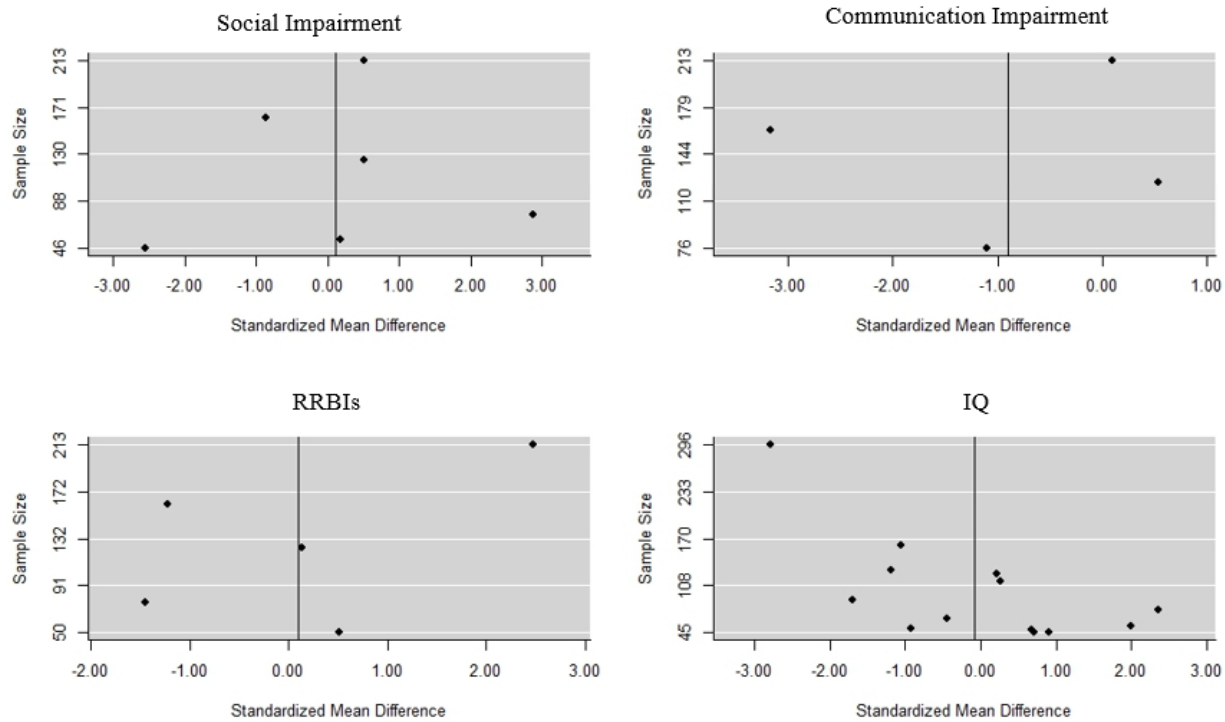


Figure 2. Funnel plot of studies included in meta-analysis of sex/gender differences in ASC and typically developing populations. Studies compared social impairments (n = 6), communication impairments (n = 4), restricted/repetitive behaviours and interests (n = 5) and IQ (n = 13).



***Social and Communication impairments.*** Table 3 displays the mean scores, test used, and sex/gender differences in social and communication impairments for ASC and TD groups. Random-effects meta-analysis found no significant differences between social impairments for ASC males or females across studies,  $SMD = -0.21$ , 95% CI [-0.44, 0.02]. Typically developing females were found to have significantly lower levels of social impairments than TD males,  $SMD = -0.23$ , 95% CI [-0.42, -0.04]. Nevertheless, a random-effects meta-analysis revealed no significant difference in the effect of sex/gender between the ASC and TD groups.

Significant heterogeneity was found in this analysis ( $Q = 158.76$ ,  $p < .001$ ), therefore the moderator Age was included in the model and found to be significant,  $QM(df = 4) = 20.53$ ,  $p < .001$ . The resulting mixed-effects meta-analysis (see Figure 3) found significant variation in sex/gender differences for social impairment between ASC and TD groups for studies including adolescents ( $n = 2$ ). However, these two studies found different patterns of variation, with the study by Sedgewick et al. (2015) finding smaller sex/gender differences in ASC adolescents than TD, and the study by Solomon et al. (2012) finding the opposite effect. In those studies which only included children or adults ( $n = 4$ ), no significant variation in sex/gender differences between ASC and TD groups was found. However, the test for residual heterogeneity was significant,  $QE(df = 2) = 43.19$ ,  $p < .001$ , indicating that other moderators, not included in the model, may still be influencing the effect of sex/gender.

No significant difference in communication impairments was found using meta-analysis for ASC males and females,  $SMD = -0.26$ , 95% CI [-0.65, 0.12], or typically developing males and females,  $SMD = -0.09$ , 95% CI [-0.44, 0.26]. A random-effects meta-analysis ( $n = 4$ ) revealed no significant difference in the effect of sex/gender for the ASC/TD groups,  $SMD = -0.90$ , 95% CI [-2.52, 0.72]; Figure 4. Significant heterogeneity was found in

this analysis ( $Q = 174.91, p < .001$ ), therefore, the moderator Age was included in the model but was not found to be significant,  $QM(df = 1) = 0.01, p = .91$ . In contrast, the test for residual heterogeneity was significant,  $QE(df = 2) = 166.56, p < .001$ , indicating that other moderators not included in the model may still be influencing the effect of sex/gender.

**Restrictive/Repetitive Behaviours and Interests (RRBIs).** Table 4 displays the mean scores, test used, and sex/gender differences for ASC and TD groups. The extent of RRBIs was not significantly different between males and females with ASC,  $SMD = -0.30$ , 95% CI [-0.66, 0.07]. Typically developing females had significantly lower levels of RRBIs than typically developing males,  $SMD = -0.29$ , 95% CI [-0.49, -0.09]. A random-effects meta-analysis ( $n = 5$ ) revealed no significant difference in the effect of sex/gender for the ASC/TD groups,  $SMD = 0.09$ , 95% CI [-1.30, 1.48; see Figure 5]. Significant heterogeneity was found in this analysis ( $Q = 255.24, p < .001$ ), therefore the moderator Age was included in the analysis. However, omnibus testing revealed no significant effect of Age,  $QM(df = 1) = 0.71, p = .40$ . In contrast, the test for residual heterogeneity was significant,  $QE(df = 3) = 225.11, p < .001$ , indicating that other moderators not included in the model may still be influencing the effect of sex/gender.

**IQ.** Table 5 displays the mean scores, test used, and sex/gender differences for ASC and TD groups. There were no significant differences between ASC male and ASC female IQ scores,  $SMD = -0.05$ , 95% CI [-0.22, 0.12], or typically developing male and female IQ scores,  $SMD = 0.02$ , 95% CI [-0.17, 0.21]. A random effects meta-analysis ( $n = 13$ ) revealed no significant difference in the effect of sex/gender for the ASC vs. TD groups,  $SMD = -0.09$ , 95% CI [-0.88, 0.71; see Figure 6]. Significant heterogeneity was found ( $Q = 453.68, p < .001$ ), therefore the moderator Age was included in a mixed-effects meta-analysis but was not found to be a significant moderator,  $QM(df = 1) = 2.45, p = .12$ . The test for residual

heterogeneity was significant,  $QE (df = 11) = 399.72, p < .001$ , indicating that other moderators not included in the model may still be influencing the effect of sex/gender.

### **Systematic Qualitative Review**

**Executive Functioning.** Executive functions are a set of abilities which facilitate higher-level cognitive control of behaviour, self-monitoring, and future planning, amongst other tasks (Ozonoff & Jensen, 1999). Individuals with ASC are often reported to have lower levels of executive functions than typically developing individuals (Happé, Booth, Charlton, & Hughes, 2006). There are contradictions in the literature when it comes to performance on specific tasks of executive functioning. All studies examined here found that as a group, individuals with ASC performed more poorly than typically developing individuals. No statistically significant interaction between sex/gender and diagnosis, was found in the Wisconsin Card Sorting Test or the Tower of Hanoi (Bolte, Duketis, Poustka & Holtmann, 2011), or the Go/No-Go task (Lai et al., 2012), suggesting that sex/gender differences may not vary between ASC and typically developing groups (see Table 2). Both studies had medium sample sizes with relatively high proportions of females in each group (compared to many studies examining sex/gender differences in ASC), but had limited power to detect small effect sizes, therefore it is possible that significant interactions were in fact undetected in these studies.

In contrast, the Trail-Making Test was found to produce significantly different sex/gender-relative performances depending on diagnostic status. In the ASC group, males had significantly longer reaction times than females, but in the typically developing group, females took longer to complete the task than males (Bolte et al., 2011). With regards to the Stop task, Lemon et al. (2011) found that ASC females demonstrated significantly longer reaction times than ASC males or typically developing females, while no differences were

found between ASC males' and typically developing males' performance on this task (see Table 2).

**Attention to Detail.** Some theories of ASC propose that individuals with ASC have a bottom-up, centrally focused processing style as opposed to the typically developing top-down, holistic processing style (Happé & Frith, 2006). Bolte and colleagues (2011) found no significant interaction between sex/gender and diagnosis for the Embedded Figures task (EFT), although a marginal interaction was found by Lai et al. (2012). In the latter study, ASC males demonstrated poorer performance on the EFT than typically developing males, while no differences were found between ASC and typically developing females. As above, it is possible that small effect sizes went undetected in these studies. However, a significant sex/gender and diagnosis interaction was found on the Block Design task (see Table 2). ASC males performed better than ASC females, whereas the reverse pattern was found for typically developing individuals (Bolte et al., 2011).

**Theory of Mind/Emotion Recognition.** The ability to infer the content of others' mental and emotional states, regardless of whether they are different to one's own, is known as theory of mind. Late or incomplete development of theory of mind abilities is considered a hallmark of ASC (Baron-Cohen, Leslie, & Frith, 1985), with some individuals failing to achieve 'simple' theory of mind abilities, such as recognising emotional expressions, and others struggling only with more complex tests, such as dynamic interactions (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997).

No significant sex/gender and diagnosis interaction was found for either the Reading the Mind in the Eyes task (RMET) or the Karolinska Directed Emotional Faces task (Holt et al., 2014; Lai et al., 2012; see Table 2). However, post-hoc analyses by Holt and colleagues (2014) revealed that ASC males performed more poorly than typically developing males on the RMET, whereas no significant differences were found between ASC and typically

developing females. Again, it should be noted that both studies had limited power to detect small effect sizes. In line with previous research, these studies found that individuals with ASC generally demonstrated poorer Theory of Mind abilities than typically developing individuals.

**Memory.** No significant sex/gender and diagnosis interaction was found on the Non-Word Repetition Task (Lai et al., 2012) or the Recent/Remote Memory task (Goddard, Dritschel, & Howlin, 2014; see Table 2). The former task is associated with (non-verbal) auditory working memory, as opposed to verbal memory tasks, which may be influenced by individuals' language abilities. The Recent/Remote Memory task measures both short-term and long-term recall memory, and is scored based on the number of details provided in response to each memory cue (Goddard, Dritschel, Robinson, & Howlin, 2014). In this task, individuals with ASC performed more poorly than typically developing individuals; otherwise there were no group differences for these tasks. However, a significant sex/gender and diagnosis interaction was found for the Autobiographical Memory Cueing Task. Males with ASC were found to produce fewer autobiographical memories than females with ASC, whereas no such difference was found between typically developing males and females (Goddard, Dritschel & Howlin, 2014).

**Empathising, Systemising and Autistic traits.** These traits represent a continuum of abilities reaching from the typical population, through those with an ASC diagnosis. Systemising ability, measured by the Systemising Quotient (SQ), represents an interest and understanding of the mechanisms within a system. High levels of these abilities are associated with more autistic traits in sub-clinical populations as well as with a diagnosis of ASC (Baron-Cohen, Richler, Bisarya, Golan, & Ashwin, 2009). In contrast, higher levels of empathising abilities (measured by the Empathising Quotient [EQ]), such as understanding others' mental states and emotions, are generally found in individuals without

an ASC diagnosis and are associated with lower levels of autistic traits in the general population (Baron-Cohen & Wheelwright, 2004). Autistic traits describe behaviours and cognitive styles associated with autism that also exist in the general population, and are proposed to be more common in typically developing males than females (Baron-Cohen, Wheelwright, Skinner, Martin & Clubley, 2001). Autistic traits are measured by the Autism Quotient (AQ).

An earlier study using smaller samples found no significant differences between ASC males and females on any of these traits, but found higher SQ traits in typically developing males, and higher EQ traits in typically developing females (Baron-Cohen et al., 2003; see Table 2). Interactions were not directly tested in this study, which was underpowered to detect small effect sizes. Baron-Cohen et al., (2001) found a significant interaction between group and sex/gender for AQ scores, with typically developing males scoring higher than females, and no sex/gender difference between ASC males and females. In contrast, a more recent study using a much larger sample and a larger proportion of females with ASC found significant interactions between sex/gender and diagnosis on all three traits (Baron-Cohen et al., 2014). Both ASC and typically developing groups displayed higher SQ and AQ scores for males, and higher EQ scores for females (see Table 2). However, sex/gender differences in these studies were significantly smaller for ASC individuals, suggesting that males and females with ASC may be more similar in their empathising, systemising and autistic traits than males and females without ASC.

The study by Park et al. (2012) did not directly test interactions, but found no significant differences between ASC males and females on the SQ or EQ. Typically developing males had higher SQ scores than equivalent females, while no sex/gender differences were found for the typically developing group on the EQ. ASC males scored higher on the AQ than ASC females, but no significant differences were found between

typically developing males and females on this measure (see Table 2). Similarly, Kirkovski et al. (2016) found that ASC females and males scored lower on the EQ and higher on the AQ than typically developing females and males. Sex/gender differences within diagnosis groups were not reported in this study.

**Friendship.** No significant interactions between sex/gender and diagnosis were found using either the Friendship Questionnaire (Baron-Cohen & Wheelwright, 2005; Head, McGillivray, & Stokes, 2014) or the Friendships Survey (Dean et al., 2014). Using both measures, ASC individuals were found to perform more poorly than typically developing individuals (see Table 2). However, one study utilizing the Friendship Qualities Scale found that males with ASC reported significantly lower closeness and helping in their best friendship than females with ASC or typically developing children of either sex/gender (Sedgewick et al., 2015).

**Internalising and Externalising.** As a group, children with ASC experienced more internalising and externalising behaviours than typically developing children. Although interactions were not tested, no sex/gender differences were found for externalising or internalising behaviours, as measured by the Child Behaviour Checklist, in either ASC or typically developing groups (Park et al., 2012). However, this study was limited by a low proportion of females with ASC, which means more subtle differences may have been missed. Similarly, internalising behaviours measured using the Behavioural Assessment System for Children revealed no sex/gender differences in either ASC or typically developing groups (Solomon, Miller, Taylor, Hinshaw, & Carter, 2012). Although this study had a moderate sample size, sex/gender and diagnosis interactions were not directly tested and the results of difference tests were not reported (see Table 2).

Through parent- and self-report, an interaction between sex, diagnosis and developmental stage was found for depressive symptoms, with ASC females demonstrating

higher levels of depressive symptoms than either ASC males or typically developing females in early adolescence (Oswald et al., 2016). However, by late adolescence ASC males and females were found to have similar levels of depressive symptoms, with the change being explained by ASC males alone having a significant increase in depressive symptoms as they got older (see Table 2). The same study also found a marginally significant interaction between sex, diagnosis and developmental stage for anxiety, with ASC females and typically developing males reporting higher levels of anxiety than ASC males and typically developing females in early adolescence, but both ASC males and females reporting higher levels of anxiety than their typically developing peers by later adolescence.

Some significant sex/gender and diagnosis interactions were found when looking at hyperactivity and inattention in particular. The study by May, Cornish, and Rinehart (2012) also looked at the effect of age on ASC-related outcomes. They found that sex/gender differences varied between ASC and typically developing groups, but that this variation depended on the age of the individuals (see Table 2). Younger males with ASC (aged 7-9 years) were more impaired than younger ASC females, compared to typical males and females. By the time these children reached the age of 10-12 years, both ASC and typically developing groups showed similar sex/gender differences, with males having higher levels of ADHD-related behaviours than females. As a group, children with ASC at all ages demonstrated higher levels of inattention and hyperactivity than typically developing children.

**Play Behaviours.** The study by Knickmeyer et al. (2008) found that ASC females demonstrate significantly less sex-typical pretend play relative to their typically developing peers than ASC males. No such sex/gender differences were found for non-pretend play, where both males and females with ASC demonstrate similar play preferences to typically developing males and females, respectively. In contrast, Harrop and colleagues (2016) found



that ASC males played with sex-typical cars and trucks less than their typically developing peers, whereas no differences in this play behaviour were found between ASC and typically developing females. While typical sex differences were found for other types of play, such as playing with dolls and houses, there were no differences between ASC females and typically developing females, or between ASC males and typically developing males. One possible explanation for these different findings is that the study by Knickmeyer et al. (2008) utilized a sample with a greater range of ages, who were on average older, than the sample used by Harrop et al. (see Table 2).

### Discussion

This study aimed to compare sex/gender differences between individuals with Autism Spectrum Conditions (ASC) and typically developing individuals, to determine whether the patterns of difference vary between these groups. A difference in sex/gender variation between groups would suggest diagnostic criteria for ASC should differ for males and females, to reflect separate ASC phenotypes for males and females.

Meta-analyses found no variation in the profiles of sex/gender differences for ASC and typically developing groups for the core ASC symptoms of communication impairments and RRBI, or for IQ. Sex/gender differences in social impairments were found to vary depending on the age of the participants. Different patterns of variation in sex/gender differences of social impairments were found for two studies including adolescents in their sample. One study found smaller sex/gender differences in ASC than TD groups, whereas the other study found larger sex/gender differences for ASC participants. No variation in sex/gender differences between groups was found for the other four samples, which included either children or adults only. Due to the small number of studies and contradictory findings in each of these studies, a conclusion of either greater or smaller sex/gender differences in

ASC social impairments cannot be drawn. However, these findings raise the importance of comparing sex/gender differences across all ages, as there may be age-related variation in the similarities and/or differences between ASC and TD groups which could not be fully assessed in this limited sample.

These results suggest that typical sex/gender differences in core symptoms and IQ also occur for individuals with ASC, and, therefore, that individuals with ASC are fundamentally similar to typically developing individuals in regard to their sex/gender variation in core ASC characteristics. This reflects the dimensional nature of ASC, such that people above and below the diagnostic threshold for ASC share traits which vary between sexes/genders.

However, the review of sex/gender differences in associated ASC symptoms revealed some degree of variation between ASC and typical populations, suggesting that having an ASC may impact differently on males and females. Males with ASC were found to have significantly more impaired performance on the trail-making task (one measure of executive function, focusing on task switching and cognitive flexibility), to produce fewer autobiographical memories, and have higher levels of hyperactivity (although only at a younger age) than females with ASC, taking into account typical sex/gender differences. In contrast, females with ASC were found to be significantly more impaired on response inhibition, as measured by the stop task, and visual-spatial processing, as measured by the block design task. Play behaviours in both males and females with ASC were found to be different to those of typically developing males and females. However, the differences appear to depend on the age of the individual, with ASC females displaying more sex-typical behaviours than males as young children, but this pattern reversing between childhood and early adolescence. Age-related patterns were also found for internalising and externalising problems. At younger ages, ASC females generally reported higher levels of internalising

problems while ASC males reported higher levels of externalising problems, a similar pattern to the typically developing groups. However, as the ASC children got older their levels of internalising and externalising problems became more similar. In particular, males with ASC demonstrated increased levels of internalising problems as they developed, bringing them to a similar level as their female peers.

Although patterns of sex/gender differences in autism, empathising, and systemising traits were the same in both groups, the differences were smaller for the ASC group, suggesting that males and females with ASC are more similar in these respects. While some of these findings contradict those using other measures of the same characteristics, they raise the suggestion that male and female performance may vary depending on the task used, and encourage further testing of sex/gender differences using a range of measures. The differences that have been found suggest that males and females with ASC are not a homogenous group, but may have distinct patterns of ability and impairment which, so far, have not been thoroughly investigated.

In contrast, no significant interactions between sex/gender and diagnosis were found for the majority of executive function tasks, attention to detail, theory of mind, most measures of friendship, and most memory tasks. These results suggest that any sex/gender differences found in ASC groups here can be attributed to typical sex/gender differences, rather than the specific differences found between males and females with ASC. When evaluating ASC sex/gender differences in these areas, typical sex/gender performance should be taken into account to gain true measures of relative ability and impairment. However, it is also possible that sex/gender variation between ASC and typically developing groups in these areas may have differed in size rather than direction, as was found for some of the cognitive traits associated with ASC. Sex/gender differences in ASC groups may therefore be broadly

similar to those found in typically developing groups for these characteristics, but these differences may be larger within one group than the other.

The smaller sex/gender differences found for ASC groups in ~~systemising, empathising~~ and autism traits suggest that males and females with ASC are more similar to each other than typically developing males and females. This offers some support for recent theories of sex/gender variation in ASC. Baron-Cohen's Extreme Male Brain theory (2002) proposes that ASC individuals are more 'masculinised' than typically developing individuals, displaying cognitive and ~~behavioural~~ patterns more similar to typically developing males than females regardless of the ASC individual's sex/gender. The Extreme Male Brain theory would therefore predict that males and females with ASC are more similar than typically developing males and females, and even that there might be no sex/gender differences within the ASC population.

In contrast, Bejerot and Eriksson (2014) suggest that both males and females with ASC are different to typically developing males and females, with individuals with ASC displaying gender-atypical patterns of ~~behaviours~~. According to this hypothesis, sex/gender differences in ASC might not be significant, but males with ASC would be different to typically developing males, and females with ASC would be different to typically developing females. Gender-atypicality in ASC would also account for the higher levels of gender dysphoria (incongruence between one's natal sex and experienced gender) found within children, adolescents and adults with ASC than within the general population (Glidden, ~~Bouman~~ & Jones, 2016). Although research into gender dysphoria in ASC is relatively limited, it has been suggested that there are different mechanisms underlying this co-occurrence within males and females (~~Pasterski~~, Gilligan & Curtis, 2014), which may reflect the differences in expression of ASC between sexes/genders found in the present study.

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Although these two theories both predict males and females with ASC will be relatively similar to each other, they offer different predictions about how individuals with ASC are similar and/or different to typically developing males and females. However, these comparisons were not directly tested in this analysis, therefore conclusions about whether individuals with ASC are more similar to typically developing males, or differ from both males and females, must be left for future research.

The differences found in male and female ASC symptoms may offer some explanation for the differences in diagnostic rates between sexes/genders in ASC. As recently suggested by Lehnhardt et al. (2015), the greater task-switching and cognitive flexibility abilities of females with ASC may explain why they are able to develop compensatory or 'camouflaging' techniques to 'mask' their social and communication impairments. Lehnhardt et al. (2015) also found higher processing speed in females than males in their adult diagnosis sample, suggesting that females with ASC are better able to use explicit cognitive strategies to cope in complex social interactions. It is possible that other cognitive and behavioural abilities found in typically developing females are also utilised by females with ASC when camouflaging, although studies of ASC sex/gender differences with typically developing controls are still limited. Further exploration of the female phenotype in ASC will give us a greater understanding of the tools and techniques used by women and girls, which may result in their being missed by clinical services.

### **Limitations**

A key limitation of this analysis is the small number of studies included, due to a dearth of research comparing ASC and typically developing groups. Meta-analysis based on a small number of studies is more susceptible to second-order sampling errors, because variation in standard deviations is more likely to be influenced by artifacts (Hunter & Schmidt, 2004). Several of the studies included in the qualitative review and meta-analyses

were underpowered to detect small effect sizes, and so it is possible that significant variation in sex/gender differences between groups was not picked up in our analysis. Consequently we echo the calls by many others (e.g., Lai et al., 2015) for future studies to include large enough numbers of males and females from both typical and ASC populations, in order to draw stronger and more consistent conclusions about sex/gender differences.

Another consequence of the limited number of studies is that few potential confounding variables were identified or controlled for. Age was included as a moderator in the meta-analyses and in some of the reviewed studies, and was found to influence sex/gender variation between groups in some areas. Previous studies have also identified IQ, ethnicity, comorbidities, and characteristics of ASC diagnosis, amongst other factors, as interacting with both sex/gender and ASC to produce differential outcomes over time (Brugha et al., 2011; Croen, Grether, & Selvin, 2002; Farley et al., 2009; Holtmann, Bölte, & Poustka, 2007). Consistent measurement and reporting of these characteristics would enable better interpretation of these studies' heterogeneity, which is a significant limitation of the present meta-analyses. Our results should be interpreted with these limitations in mind, although we conclude that the finding of some significant variation in sex/gender differences, despite these limitations, is robust and meaningful.

Although the most recent DSM-5 diagnostic criteria have combined social and communication impairments into one symptom, we analysed them separately. This is because some of the studies included in this analysis only measured either social or communication impairments, therefore scores for both could not be combined for all studies. In addition, hypo/hyper-reactivity to sensory stimulation is a criterion in DSM-5, but was not measured in many of the studies included here. Conclusions therefore cannot be directly applied to the most recent DSM-5 criteria, but still apply to the ICD-10 diagnostic criteria.

A final limitation is that this study was focused on behavioural and cognitive characteristics of ASC only. While these characteristics are of the most relevance to diagnostic criteria (as physiological markers of ASC have not been identified, and therefore diagnosis relies on behavioural information solely), there are many other characteristics of ASC which also display sex/gender variation. This paper lacks the space to offer a full review of sex/gender differences in all areas of research relating to ASC. However, see recent reviews by Kirkovski et al. (2013), Lai et al. (2015), and Werling and Geschwind (2013) for more information on sex/gender differences in neurodevelopmental, biological and genetic factors amongst other characteristics. A comparison of sex/gender differences between ASC and typically developing groups in these characteristics would further broaden our understanding of the expression of ASC in both males and females.

### **Conclusions**

The present results suggest that ASC may have differential impacts on individuals depending on their sex/gender. While differences in core symptoms and IQ reflect typical sex/gender patterns of ability, ASC appears to produce different patterns of some associated ASC characteristics for males and females, beyond typical sex/gender variation. This supports the conclusions of several previous reports, that females with ASC may present different cognitive and/or behavioural phenotypes to most males with ASC, and that clinicians should be mindful of these differences during assessment and diagnosis. We also suggest that there are many individual factors, including age, IQ, and social background, which may interact with an ASC to produce variations in development, and so should not be disregarded in favour of the 'typical' ASC presentation. A significant limitation of this study was the small number of studies available for review. Future research can address this by ensuring all sex/gender comparisons within ASC individuals include a comparison group of

typically developing males and females, to guarantee that sex/gender differences in the general population are accounted for in analyses.

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### **Notes**

<sup>1</sup>Individuals on the autism spectrum have reported that the term ‘disorder’ is stigmatising and does not reflect the range of strengths and difficulties experienced by those on the spectrum. Following previous researchers (e.g. Lai & Baron-Cohen, 2015), we use the term ‘Autism Spectrum Condition’ (ASC) in reference to those diagnosed with an autism spectrum disorder.

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Table 1  
*Sample characteristics of studies included in review*

Paper	Authors (Date)	ASC symptom(s) assessed	ASC group diagnoses at time of study	ASC diagnostic criteria used	How diagnosis confirmed	ASC Group			Typically Developing Group		
						Males (n)	Females (n)	Mean age (years)	Males (n)	Females (n)	Mean age (years)
1	Baron-Cohen et al. (2014)	Empathising traits Systemising traits Autism traits	AS (62%) ASD (29%) HFA (5%) PDD (2%) Autism (1%)	Not reported	Not reported	357	454	34.7	1344	2562	34.4
2	Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright (2003)	Empathising traits Systemising traits	AS/HFA (proportions not reported)	DSM-IV criteria for Autism/AS	Not reported	33	14	38.1	114	164	30.9
3	Baron-Cohen & Wheelwright (2005)	Friendships	AS/HFA (proportions not reported)	DSM-IV criteria for Autism/AS	Not reported	51	17	34.4	27	49	40.5
4	Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley (2001)	Autism traits	AS/HFA (proportions not reported)	DSM-IV criteria for Autism/AS	Not reported	45	13	31.6	76	98	37
5	Bölte, Duketis, Poustka, & Holtmann (2011)	IQ Executive functions	Autism (68%) AS (20%) PDD-NOS (13%)	ICD-10 criteria for Autism/AS/PD D-NOS	Clinician assessment & ADI-R /ADOS	35	21	14.2	23	35	14.6

6	Dean et al. (2014)	Friendships	ASD (100%)	Not reported	Clinician assessment & ADOS	25	25	7.5	25	25	7.8
7	Goddard, Dritschel, & Howlin (2014)	IQ Memory	ASD (100%)	DSM-IV-TR criteria for ASD	Clinician assessment & SCQ	12	12	12.9	12	12	12.6
8	Harrop, Green & Hudry (2016)	IQ Play behaviours	ASD (100%)	Not reported	ADI-R /ADOS	14	14	3.8	14	12	2.0
9	Head, McGillivray, & Stokes (2014)	Friendships	ASD (not including LFA or PDD-NOS; 100%)	Not reported	Not reported	25	25	13.7	26	25	12
10	Holt et al. (2014)	IQ Theory of mind	AS/HFA (proportions not reported)	Not reported	ADI-R /ADOS	33	16	14.6	20	20	15.1
11	Kirkovski, Euticott, Hughes, Rossell, & Fitzgerald (2016)	IQ Social impairments RRBIs Empathising traits Autism traits	AS (85%) HFA (15%)	DSM-IV-TR criteria for ASD	Viewing of clinician diagnostic report	13	14	30.7	11	12	30.7
12	Knickmeyer, Wheelwright & Baron-Cohen (2008)	Play behaviours	Of those available (91% of total sample): AS (32%) Autism (58%) HFA (3%)	ICD-10 or DSM-IV criteria for ASC	Not reported	46	20	10.2	31	24	5.2

			PDD-NOS (3%) Atypical Autism (2%)								
13	Lai et al. (2012)	IQ Executive functions Theory of mind Memory	AD/AS (proportions not reported)	ICD-10 or DSM-IV criteria for ASC	ADI-R /ADOS /AAA	32	32	27.6	32	32	28.2
14	Lemon, Gargaro, Enticott, & Rinehart (2011)	IQ Executive functions	HFA (70%) AS (30%)	DSM-IV criteria for HFA/AS	Clinician assessment	10	13	11	8	14	11.4
15	May, Cornish & Rinehart (2012)	Social impairment Communication impairment RRBIs IQ Inattention/ hyperactivity	AS (64%) AD (36%)	DSM-IV-TR criteria for AS/AD	Viewing of clinician diagnostic report	32	32	9.9	30	30	9.3
16	Oswald et al. (2016)	IQ <del>Internalising</del> problems	ASD (100%)	Not reported	AQ/ASDS	18	14	14.8	18	14	14.9

17	Park et al. (2012)	Social impairment Communication impairment RRBIs IQ <del>Internalising problems</del> <del>Externalising problems</del>	ASD (100%)	DSM-IV-R criteria for PDDs	Clinician assessment	91	20	8.3	26	25	8.6
18	Sedgewick, Hill, Yates, Pickering & Pellicano (2015)	Social impairment IQ Friendships	Autism (83%) AS (17%)	DSM-IV-TR or ICD-10 criteria for autism/ AS	Clinician assessment and statement of special educational needs indicating autism	10	13	13.9	10	13	13.8
19	Solomon et al. (2012)	Social impairment Communication impairment RRBIs IQ <del>Internalising problems</del>	ASD including HFA, AS & PDD-NOS (proportions not reported)	DSM-IV-TR criteria for AD/AS/ PDD-NOS	ADOS/SDQ	20	20	12.2	17	19	12

20	Zwaigenbaum et al. (2012)	Social impairment Communication impairment RRBIs	Not reported	DSM-IV-TR criteria for ASD	Viewing of clinician diagnostic report & ADI-R/ ADOS	57	28	3.3	64	64	3.3
		IQ				55	25	3.3	63	63	3.3

*Note.* RRBIs = Restricted, Repetitive Behaviours & Interests; AS = Asperger Syndrome; ASD = Autism Spectrum Disorder; HFA = High Functioning Autism; PDD = Pervasive Developmental Disorder; PDD-NOS = Pervasive Developmental Disorder, Not Otherwise Specified; LFA = Low Functioning Autism; AD = Autistic Disorder; ADI-R = Autism Diagnostic Interview (Revised); ADOS = Autism Diagnostic Observation Schedule; SCQ = Social Communication Questionnaire; AAA = Adult Asperger Assessment; DSM-IV = Diagnostic & Statistical Manual of Mental Disorder (4<sup>th</sup> Edition); ASDS = Asperger Syndrome Diagnostic Scale; AQ = Autism Spectrum Quotient; DSM-IV-TR = Diagnostic & Statistical Manual of Mental Disorder (4<sup>th</sup> Edition, Text Revision); ICD-10 = International Classification of Diseases (10<sup>th</sup> Edition)

Table 2

*Measures and key findings of papers included in review*

Paper	Authors (date)	Outcome measures	Key findings
1	Baron-Cohen et al. (2014)	EQ SQ AQ	EQ: significant interaction between Sex and Diagnosis found smaller sex differences in ASC than TD group (F [df = 1, 4351] = 14, $p < .001$ , $\omega = .06$ ); ASC Female > ASC Male (F [df = 1, 4351] = 33.4, $p < .001$ , $d = .40$ ); TD Female > TD Male (F [df = 1, 4351] = 455, $p < .001$ , $d = .76$ ). SQ: significant interaction between Sex and Diagnosis found smaller sex differences in ASC than TD group (F [df = 1, 4146] = 11.6, $p < .001$ , $\omega = .06$ ); ASC Male > ASC Female (F [df = 1, 4146] = 15.6, $p < .001$ , $d = .27$ ); TD Male > TD Female (F [df = 1, 4146] = 275.36, $p < .001$ , $d = .61$ ). AQ: significant interaction between Sex and Diagnosis found smaller sex differences in ASC than TD group (F [df = 1, 4713] = 3.94, $p = .047$ , $\omega = .02$ ); ASC Male > ASC Female (F [df = 1, 4713] = 10.97, $p < .001$ , $d = .18$ ); TD Male > TD Female (F [df = 1, 4713] = 133, $p < .001$ , $d = .41$ ).

2	Baron-Cohen, Richler, Bisarya, Gurunathan & Wheelwright (2003)	EQ SQ	EQ: no significant difference between ASC Female and ASC Male ( $t [df = 18.68] = 1.09, p = .22$ ); TD Female > TD Male ( $F [df = 1, 269] = 38.6, p < .001$ ). SQ: no significant difference between ASC Female and ASC Male ( $t [df = 45] = -0.46, p > .65$ ); TD Male > TD Female ( $F [df = 1, 270] = 18.1, p < .001$ ).
3	Baron-Cohen & Wheelwright (2005)	FQ	FQ: no significant interaction between Sex and Diagnosis ( $F [df = 1, 139] = 3.5, p = .06$ ); TD > ASC ( $F [df = 1, 139] = 51.6, p < .001$ ); Female > Male ( $F [df = 1, 139] = 16.8, p < .001$ ).
4	Baron-Cohen, Wheelwright, Skinner, Martin & Clubley (2001)	AQ	AQ: significant interaction between Sex and Diagnosis ( $F [df = 1, 228] = 6.01, p .02$ ); no significant difference between ASC Female and ASC Male (statistical tests not reported); TD Male > TD Female ( $t = 2.56, p < .01$ ).
5	Bolte, Duketis, Poustka & Holtmann (2011)	WISC WCST ToH TMT EFT BDT	WISC: no significant interaction between Sex and Diagnosis ( $F = 0.07, p = .79, \text{partial } \eta^2 = .00$ ). WCST: no significant interaction between Sex and Diagnosis ( $F = 0.09, p = .75, \text{partial } \eta^2 = .00$ ). ToH: no significant interaction between Sex and Diagnosis for number of moves ( $F = 2.22, p = .07, \text{partial } \eta^2 = .03$ ) or completion time ( $F = 0.00, p = .96, \text{partial } \eta^2 = .00$ ). TMT: significant interaction between Sex and Diagnosis ( $F = 3.91, p = .04, \text{partial } \eta^2 = .04$ ); ASC Females were faster than ASC Males (statistical tests not reported); ASC Males were faster than ASC Females (statistical tests not reported). EFT: no significant interaction between Sex and Diagnosis ( $F = 0.02, p = .88, \text{partial } \eta^2 = .00$ ). BDT: significant interaction between Sex and Diagnosis ( $F = 5.56, p = .02, \text{partial } \eta^2 = .05$ ); ASC Males performed better than ASC Females (statistical tests not reported); ASC Females performed better than ASC Males (statistical tests not reported).
6	Dean et al. (2014)	Friendships Survey	Friendships Survey: no significant interaction between Sex and Diagnosis for social preferences ( $F [df = 1, 96] = 1.09, p = .30, \omega^2 = 0.2$ ), social acceptance ( $F [df = 4, 95] = .41, p = .53, \omega^2 = 1.35$ ), or social connections ( $F [df = 3, 96] = 1.35, p = .25, \omega^2 = .01$ ).

7	Goddard, Dritschel & Howlin (2014)	WASI BPVS AMCT RRMT	WASI: no significant difference between ASC and TD scores ( $t = .12, p = .94$ ). BPVS: no significant difference between ASC and TD scores ( $t = 1.3, p = .24$ ). AMCT: significant interaction between Sex and Diagnosis ( $F [df = 1, 44] = 4.24, p = .045, \eta^2 = .09$ ); ASC Females produced more autobiographical memories than ASC Males (statistical tests not reported); no difference between TD Females and TD Males (statistical tests not reported). RRMT: no significant interaction between Sex and Diagnosis (statistical tests not reported).
8	Harrop, Green & Hudry (2016)	Mullen ELC Toy Engagement	Mullen: no significant difference between ASC Female and ASC Male ( $t [df = 26] = 9.15, p = .37$ ); no significant difference between ASC and TD scores ( $t [df = 3, 50] = 0.94, p = .96$ ). Toy Engagement: significant interaction between Sex and Diagnosis for garage and cars ( $F [df = 3, 50] = 20.21, p < .001$ ); TD Males played more than ASC Males ( $p = .04$ ), or TD Females and ASC Females ( $p < .001$ ); no significant interactions for other types of play.
9	Head, McGillivray & Stokes (2014)	FQ	FQ: no significant interaction between Sex and Diagnosis ( $F [df = 1, 101] = 1.00, p > .05, \eta^2 = .01$ ); ASC Females > ASC Males ( $t [df = 48] = -3.64, p < .05$ ).
10	Holt et al. (2014)	WASI RMET	WASI: no significant difference between ASC Male and TD Male (statistical tests not reported); ASC Female < TD Female ( $p = .001$ ). RMET: ASC < TD ( $p = .002$ ); ASC Male < TD Male ( $F [df = 2, 61] = 3.39, p = .004$ ); no significant difference between ASC Female and TD Female ( $F [df = 2, 60] = 2.02, p = .141$ ); no significant interaction between Sex and Diagnosis (statistical tests not reported).
11	Kirkovski, Enticott, Hughes, Rossell & Fitzgerald (2016)	KBIT-2 RAADS-R EQ AQ	KBIT-2: no significant difference between ASC and TD (statistical tests not reported). RAADS-R: ASC > TD on all subscales (statistical tests not reported). EQ: ASC < TD (statistical tests not reported). AQ: ASC > TD (statistical tests not reported).
12	Knickmeyer, Wheelwright & Baron-Cohen (2008)	CPQ	CPQ: Sex-typical play shown by TD Females ( $t [df = 42] = 11.58, p < .001$ ), TD Males ( $t [df = 60] = 13.55, p < .001$ ) and ASC Males ( $t [df = 45] = 11.8, p < .001$ ); Sex-typical play not shown by ASC Females ( $t [df = 19] = -1.30, p = .21$ ).



13	Lai et al. (2012)	WASI Go/No-Go Task EFT RMET KDEFT NWRT	WASI: no significant difference between Female ASC, Male ASC, Female TD or Male TD groups (statistical tests not reported). Go/No-Go Task: no significant interaction between Sex and Diagnosis ( $F [df = 2, 120] = 0.173, p = .842$ , Pillai's Trace $V = .003$ ). EFT: marginally significant interaction between Sex and Diagnosis ( $F [df = 1, 122] = 137.40, p < .001$ ); ASC M < TD M ( $p = .001$ ); no significant difference between ASC F and TD M ( $p = .83$ ); no significant difference between ASC F and ASC M ( $p = .04$ ); TD M > TD F ( $p < .001$ ). RMET: no significant interaction between Sex and Diagnosis ( $F [df = 1, 122] = 0.42, p = .521$ , partial $\eta^2 = .003$ ). KDEFT: no significant interaction between Sex and Diagnosis on any emotion (see paper for test results). NWRT: no significant interaction between Sex and Diagnosis ( $F [df = 1, 122] = 0.23, p = .635$ , Pillai's Trace $V = .002$ ).
14	Lemon, Gargaro, Enticott & Rinehart (2011)	WISC Stop Task	WISC: no statistical tests reported. Stop Task: Significant effect of Group ( $F [df = 3, 19] = 3.87, p = .026$ ); ASC Females were slower than TD Females ( $p = .002, d = 1.30$ ) and TD Males ( $p = .025, d = 0.86$ ); no significant difference between ASC Males and TD Males ( $p = .919, d = 0.05$ ).
15	May, Cornish & Rinehart (2012)	SRS CCC RBQ WISC/WASI SWAN Conners 3 Parent Short Form	SRS: no significant interaction between Sex and Diagnosis (statistical tests not reported); ASC Group > TD Group ( $F = 229.871, p < .001$ ); no sex differences ( $F = 0.996, p$ not reported). CCC: no significant interaction between Sex and Diagnosis (statistical tests not reported); ASC Group < TD Group on all subscales (see paper for test results); Males < Females for some subscales (see paper for test results). RBQ: no significant interaction between Sex and Diagnosis (statistical tests not reported); ASC Group > TD Group ( $F = 85.397, p < .001$ ); Males > Females for one subscale (see paper for test results). WISC/WASI Full-Scale IQ: TD Group > ASC Group ( $F = 7.716, p < .001$ ). SWAN: ASC Group > TD Group for hyperactivity ( $F = 60.08, p < .001$ ) and inattention ( $F = 83.08, p < .001$ ); Males > Females for hyperactivity ( $F = 4.51, p < .05$ ) and inattention ( $F = 4.28, p < .05$ ). Conners 3: significant interaction between Sex, Age and Diagnosis for hyperactivity ( $F [df = 1, 122] = 4.279, p = .041$ ); no sex differences for inattention ( $F = 2.981, p$ not reported); ASC Group > TD Group for inattention ( $F = 80.089, p < .001$ ).
16	Oswald et al. (2016)	KBIT-2 RCADS MASC CES-D	KBIT-2: no significant difference between ASC and TD scores ( $F < 0.01, p$ not reported). RCADS: significant interaction between Sex, Diagnosis, and Developmental Stage ( $F [df = 2, 54] = 3.30, p = .04$ , partial $\eta^2 = 0.11$ ); ASC Female > ASC Male and TD Female in early adolescence but no difference between ASC Female and ASC Male by late adolescence (all $p$ 's < .01).

17	Park et al. (2012)	SCQ ASDS ADI-R LIPS CBC AQ EQ SQ	<p>MASC: marginally significant interaction between Sex, Diagnosis, and Developmental Stage (<math>F [df = 1, 55] = 3.79, p = .06, \text{partial } \eta^2 = 0.06</math>; ASC Female &gt; ASC Male and TD Female in early adolescence (all <math>p</math>'s &lt; .01).</p> <p>CES-D: marginally significant interaction between Sex, Diagnosis, and Developmental Stage (<math>F [df = 4, 51] = 2.17, p = .09, \text{partial } \eta^2 = 0.15</math>; ASC Female and TD Male &gt; ASC Male and TD Female in early adolescence but ASD Female and Male &gt; TD Female and Male by late adolescence (all <math>p</math>'s &lt; .05).</p> <p>SCQ: ASC Male &gt; ASC Female (<math>t = 2.27, p &lt; .001</math>); no significant difference between TD Male and TD Female (<math>t = 0.62, p = .54</math>).</p> <p>ASDS: no significant difference between ASC Female and ASC Male on any subscale (see paper for test results); no significant difference between TD Female and TD Male on any subscale (see paper for test results).</p> <p>ADI-R: ASC Male &gt; ASC Female for communication impairments (<math>t = 2.34, p = .028</math>) and repetitive, stereotyped behaviours (<math>t = 2.03, p = .045</math>); no significant difference between TD Female and TD Male for any core ASC symptom (see paper for test results).</p> <p>LIPS: TD Group &gt; ASC Group (<math>F = 26.80, p &lt; .001</math>).</p> <p>CBC: no significant difference between ASC Female and ASC Male on any subscale (see paper for test results); no significant difference between TD Female and TD Male on any subscale (see paper for test results).</p> <p>AQ: ASC Male &gt; ASC Female (<math>t = 2.19, p = .031</math>); no significant difference between TD Male and TD Female (<math>t = 1.76, p = .085</math>).</p> <p>EQ: no significant difference between ASC Female and ASC Male (<math>t = -0.53, p = .605</math>); no significant difference between TD Female and TD Male (<math>t = -1.67, p = .104</math>).</p> <p>SQ: no significant difference between ASC Female and ASC Male (<math>t = 0.87, p = .388</math>); TD Male &gt; TD Female (<math>t = 2.52, p = .016</math>).</p>
18	Sedgewick, Hill, Yates, Pickering & Pellicano (2015)	SRS WAIS FQS	<p>SRS: significant interaction between Sex and Diagnosis (<math>F [df = 1, 42] = 4.79, p = .03, \text{partial } \eta^2 = .10</math>); ASC M &gt; ASC F (<math>t [df = 21] = .242, p = .03, d = 1.03</math>); no significant difference between TD M and TD F (<math>t [df = 21] = .26, p = .12</math>).</p> <p>WAIS: no significant effect of Sex (<math>p &gt; .33</math>) or Diagnosis (<math>p &gt; .18</math>); no significant interaction between Sex and Diagnosis (<math>p &gt; .33</math>).</p> <p>FQS: significant interaction between Sex and Diagnosis for Help (<math>F [df = 1, 42] = 6.21, p = .01, \text{partial } \eta^2 = .13</math>) and Closeness (<math>F [df = 1, 42] = 6.26, p = .01, \text{partial } \eta^2 = .13</math>) subscales; no significant interactions found for other subscales (see paper for test results).</p>

19	Solomon et al. (2012)	SRS CCC RBS WASI BASC	<p>SRS: no significant difference between ASC Female and ASC Male on any subscale (statistical tests not reported); ASC Female &gt; TD Female on all subscales (statistical tests not reported); no difference between ASC Male and TD Male on any subscale (statistical tests not reported); no difference between TD Female and TD Male on any subscale (statistical tests not reported).</p> <p>CCC: no significant difference between ASC Female and ASC Male on any subscale (statistical tests not reported); TD Female &gt; ASC Female on all subscales (statistical tests not reported); TD Male &gt; ASC Male on all subscales (statistical tests not reported); no significant difference between TD Female and TD Male (statistical tests not reported).</p> <p>RBQ: no significant difference between ASC Female and ASC Male on any subscale (statistical tests not reported); ASC Female &gt; TD Female for all subscales but one (statistical tests not reported); ASC Male &gt; TD Male for all subscales (statistical tests not reported); no significant difference between TD Female and TD Male (statistical tests not reported).</p> <p>WASI: TD group &gt; ASC group (statistical tests not reported).</p> <p>BASC: no significant difference between ASC Female and ASC Male on any subscale (statistical tests not reported); ASC Female &gt; TD Female on all subscales (statistical tests not reported); ASC Male &gt; TD Male on depression only (statistical tests not reported); no significant difference between TD Female and TD Male (statistical tests not reported).</p>
20	Zwaigenbaum et al. (2012)	ADI-R Mullen ELC	<p>ADI-R: no significant interaction between Sex and Diagnosis for any subscale (see paper for test results); Males &gt; Females for communication (<math>F = 19.5, p &lt; .001</math>) and social impairments (<math>F = 3.95, p = .049</math>); ASC Group &gt; TD Group for all subscales (see paper for test results).</p> <p>Mullen ELC: no significant interaction between Sex and Diagnosis for any subscale (see paper for test results).</p>

*Note.* Degrees of freedom (df) for tests are included where reported in original papers. ASC = Autism Spectrum Condition; TD = Typically Developing; EQ = Empathising Quotient; SQ = Systemising Quotient; AQ = Autism Quotient; FQ = Friendship Quotient; WISC = Wechsler Intelligence Scales for Children; WCST = Wisconsin Card Sort Test; ToH = Tower of Hanoi; TMT = Trail-Making Test; EFT = Embedded Figures Test; BDT = Block Design Test; WASI = Wechsler Abbreviated Scale of Intelligence; BPVS = British Picture Vocabulary Scale; AMCT = Autobiographical Memory Cueing Task; RRMT = Recent & Remote Memory Task; CPQ = Child Play Questionnaire; RMET = Reading the Mind in the Eyes Task; Karolinska Directed Emotional Faces Task; NWRT = Non-Word Repetition Task; SRS = Social Responsiveness Scale; CCC = Children's Communication Checklist; RBS = Repetitive Behaviours Scale; SWAN = Strengths and Weaknesses in Attention-Deficit Hyperactivity Symptoms; SCQ = Social Communication Questionnaire; ASDS = Asperger Syndrome Diagnostic Scale; RBQ = Repetitive Behaviours Questionnaire; ADI-R = Autism Diagnostic Interview – Revised; LIPS = Leiter International Performance Scale; CBC = Child Behavioural Checklist; BASC = Behaviour Assessment System for Children; Mullen ELC = Mullen Early Learning Composite; KBIT-2 = Kaufman Brief Intelligence Test – Second Edition; RAADS-R = Ritvo Autism and Asperger's Diagnostic Scale—Revised; FQS = Friendship

Qualities Scale; RCADS = Revised Child Anxiety & Depression Scale; MASC = Multidimensional Anxiety Scale for Children; CES-D = Centre for Epidemiological Studies Depression Scale

Table 3

*Sex/gender differences in social and communication impairments for Autism Spectrum Condition (ASC) and typically developing (TD) groups*

Social Impairments								
Authors (date)	Test used	Age of participants	ASC			TD		
			Female (SD)	Male (SD)	SMD [95% CI]	Female (SD)	Male (SD)	SMD [95% CI]
Kirkovski et al. (2016)	RAADS-R Social Relatedness subscale	Adult	28.36 (13.87)	28.77 (13.80)	-0.03 [-0.78, 0.73]	3.92 (4.01)	4.36 (4.61)	-0.10 [-0.87, 0.67]
May, Cornish & Rinehart (2012)	SRS	Child	97.41 (31.77)	99.97 (22.71)	-0.09 [-0.58, 0.40]	23.17 (16.49)	27.30 (20.42)	-0.22 [-0.73, 0.29]
Park et al. (2012)	ADI-R social subscale	Child	8.55 (4.43)	10.25 (3.83)	-0.43 [-0.92, 0.06]	1.00 (1.22)	1.28 (1.46)	-0.20 [-0.76, 0.35]
Sedgewick et al. (2015)	SRS	Adolescent	72.00 (32.39)	103.00 (27.76)	-0.98 [-1.85, -0.11]	43.00 (13.18)	40.00 (26.16)	0.15 [-0.68, 0.97]
Solomon et al. (2012)	SRS	Child/ Adolescent	103.85 (27.64)	104.60 (32.04)	-0.02 [-0.64, 0.60]	18.11 (18.79)	62.81 (60.81)	-1.00 [-1.69, -0.30]

Zwaigenbaum et al. (2012)	ADI-R social subscale	Child	10.75 (7.00)	11.30 (5.90)	-0.09 [-0.54, 0.37]	2.25 (2.34)	2.70 (2.66)	-0.18 [-0.44, 0.08]
Communication Impairments								
Authors (date)	Test used	Age of participants	ASC			TD		
			Female (SD)	Male (SD)	SMD [95% CI]	Female (SD)	Male (SD)	SMD [95% CI]
May, Cornish & Rinehart (2012)	CCC – global communication subscale	Child	36.75 (15.05)	33.19 (16.00)	0.23 [-0.26, 0.72]	80.60 (22.94)	78.63 (19.78)	0.09 [-0.42, 0.60]
Park et al. (2012)	ADI-R nonverbal communication subscale	Child	17.75 (8.20)	22.31 (6.16)	-0.69 [-1.18, -0.20]	1.80 (2.33)	1.50 (1.90)	0.14 [-0.41, .69]
Solomon et al. (2012)	CCC – global communication Subscale	Child/ Adolescent	76.00 (14.93)	80.95 (24.55)	-0.24 [-0.86, 0.38]	113.05 (16.20)	111.00 (16.37)	0.12 [-0.53, 0.78]
Zwaigenbaum et al. (2012)	ADI-R communication subscale	Child	8.71 (4.54)	10.09 (3.61)	-0.35 [-0.80, 0.11]	1.71 (2.14)	2.85 (2.86)	-0.45 [-0.71, -0.19]

Note. SD = Standard Deviation; SMD = Standardised Mean Difference; CI = confidence interval; SRS = Social Responsiveness Scale; ADI-R =

Autism Diagnostic Interview – Revised; RAADS-R = Ritvo Autism and Asperger’s Diagnostic Scale—Revised; CCC = Child Communication

Checklist; ADI-R = Autism Diagnostic Interview – Revised



Figure 3

Meta-analysis of studies comparing differences in sex/gender variation in social impairment between ASC and TD groups

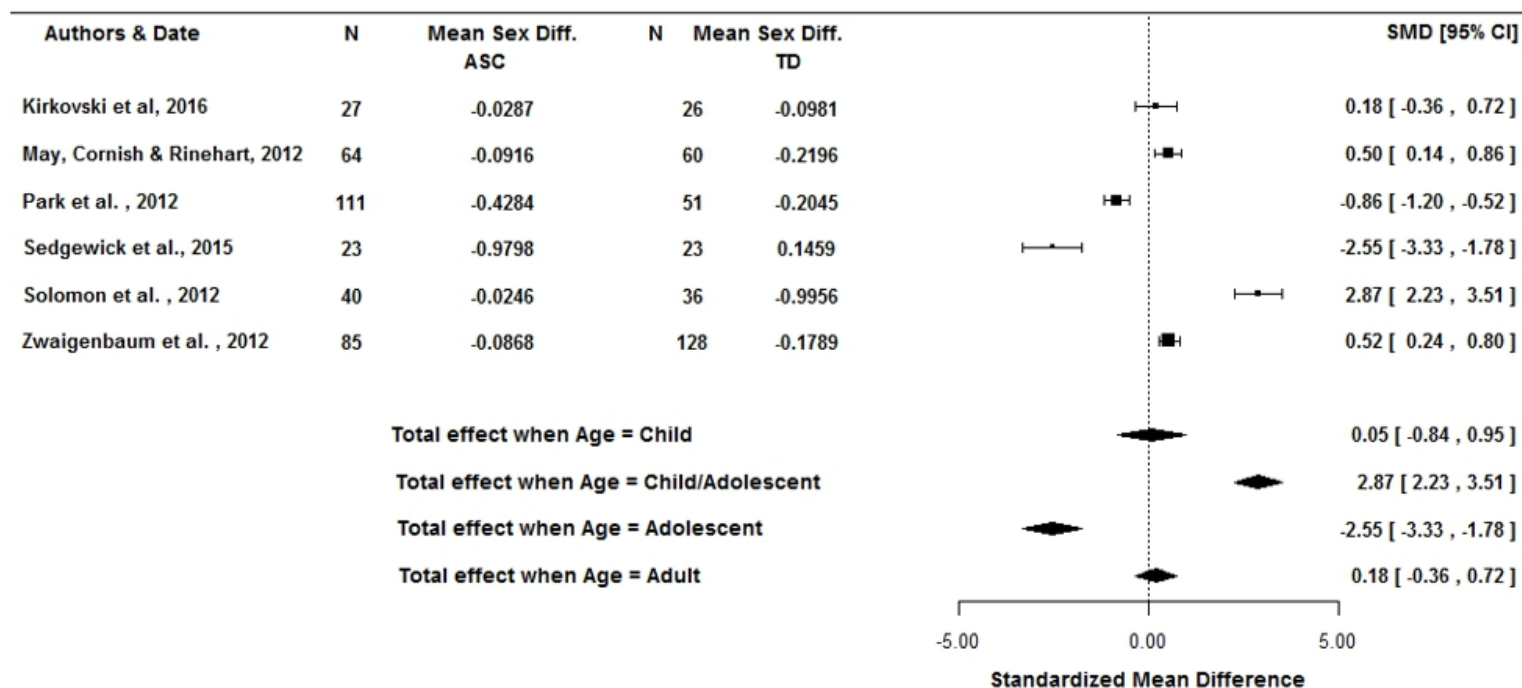


Figure 3. Forest plot of standardised mean differences (SMD) for social impairment in each study and total SMD at each level of moderator 'Age', drawn in R using 'metafor' package (Viechtbauer, 2010; R Foundation for Statistical Computing, Vienna, Austria). Central rectangle indicates mean effect; lines indicate 95% confidence intervals. Negative effects indicate smaller sex/gender differences in ASC groups than in TD groups; positive effects indicate larger sex/gender differences in ASC groups than in TD groups. If lines cross the y axis, effect is not significant. Rectangles indicate the effect size (SMD) in each study, with the size of the rectangle indicating the 'weight' of the study (determined by the sample size and the precision of the confidence intervals). Diamonds indicate the average effect size in each group of studies,

wider diamonds indicating wider confidence intervals of the effect. ASC = Autism Spectrum Condition group; TD = typically developing group; CI = confidence interval.

Figure 4  
 Meta-analysis of studies comparing differences in sex/gender variation in communication impairment between ASC and TD groups

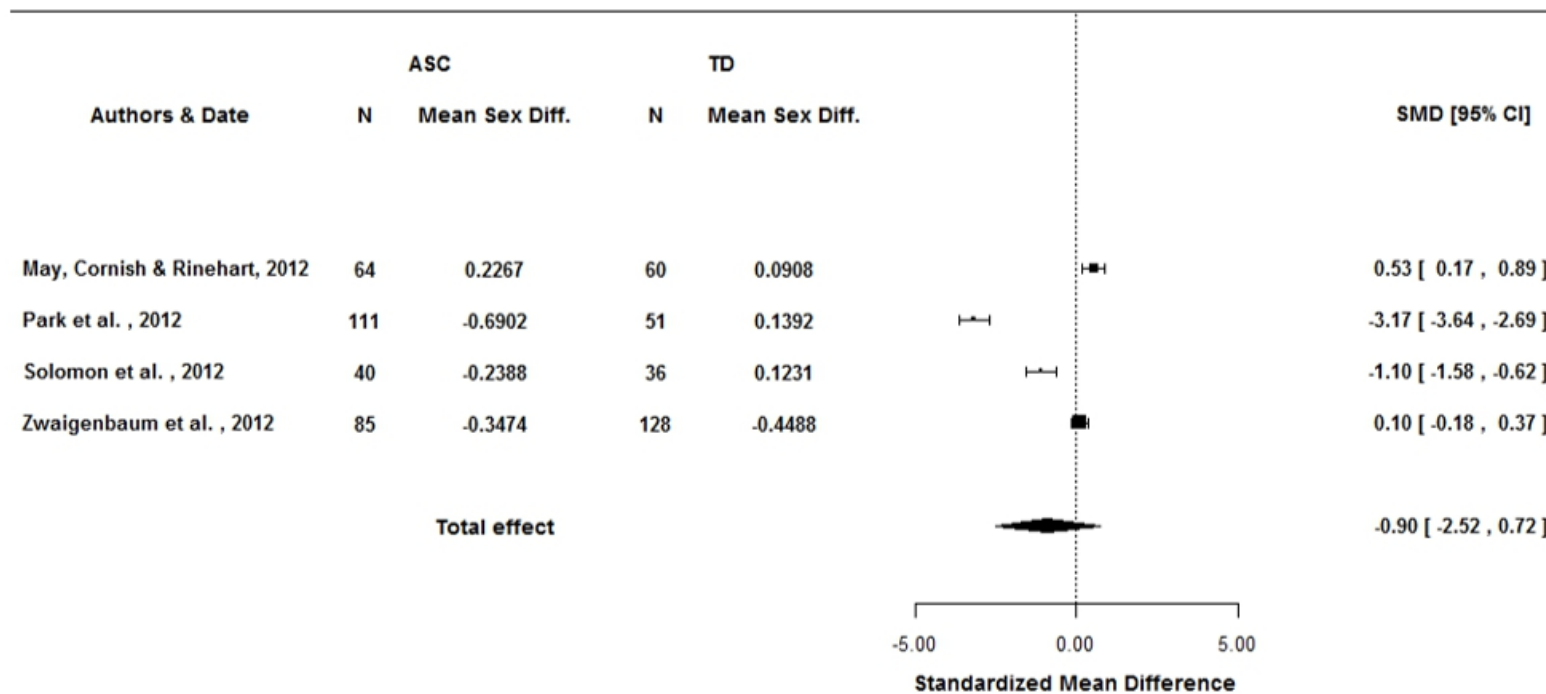


Figure 4. Forest plot of standardised mean differences (SMD) for communication impairment in each study and total SMD from all studies, drawn in R using ‘metafor’ package (Viechtbauer, 2010; R Foundation for Statistical Computing, Vienna, Austria). Central rectangle indicates mean effect; lines indicate 95% confidence intervals. Negative effects indicate smaller sex/gender differences in ASC groups than in TD groups;



positive effects indicate larger sex/gender differences in ASC groups than in TD groups. If lines cross the y axis, effect is not significant. Rectangles indicate the effect size (SMD) in each study, with the width of the rectangle indicating the ‘weight’ of the study (determined by the sample size and the precision of the confidence intervals). The diamond indicates the average effect across all studies, with the width of the

Authors (date)	Test used	Age of participants	ASC			TD		
			Female (SD)	Male (SD)	SMD [95% CI]	Female (SD)	Male (SD)	SMD [95% CI]
Kirkovski et al. (2016)	RAADS-R Circumscribed Interests	Adult	53.79 (21.67)	57.00 (12.85)	-0.17 [-0.93, 0.58]	8.42 (5.84)	12.09 (12.00)	-0.38 [-1.21, 0.45]
May, Cornish & Rinehart (2012)	RBQ	Child	35.48 (31.77)	38.34 (9.01)	-0.12 [-0.61, 0.37]	23.23 (4.52)	23.86 (3.42)	-0.16 [-0.66, 0.35]
Park et al. (2012)	ADI-R RSB subscale	Child	4.10 (2.51)	5.48 (2.79)	-0.50 [-0.99, -0.01]	0.36 (0.70)	0.50 (0.81)	-0.18 [-0.73, 0.37]
Solomon et al. (2012)	RBS	Child/ Adolescent	2.47 (1.77)	5.00 (3.16)	-0.97 [-1.62, -0.31]	0.00 (0.00)	0.41 (1.23)	-0.48 [-1.14, 0.19]
Zwaigenbaum et al. (2012)	ADI-R RSB subscale	Child	4.43 (2.60)	4.07 (2.68)	0.13 [-0.32, 0.59]	0.74 (1.26)	1.21 (1.74)	-0.31 [-0.57, -0.05]

diamond indicating the confidence intervals of the effect. ASC = Autism Spectrum Condition group; TD = typically developing group; CI = confidence interval.

Table 4

*Sex/gender differences in Restrictive/Repetitive Behaviours and Interests (RRBIs) for ASC and TD groups*

Note: CI = confidence interval; RBQ = Repetitive Behaviours Questionnaire; RBS = Repetitive Behaviours Scale; ADI-R = Autism Diagnostic Interview – Revised; RAADS-R = Ritvo Autism and Asperger’s Diagnostic Scale—Revised

Figure 5

Meta-analysis of studies comparing differences in sex/gender variation in restricted/repetitive behaviours and interests (RRBIs) between ASC and TD groups

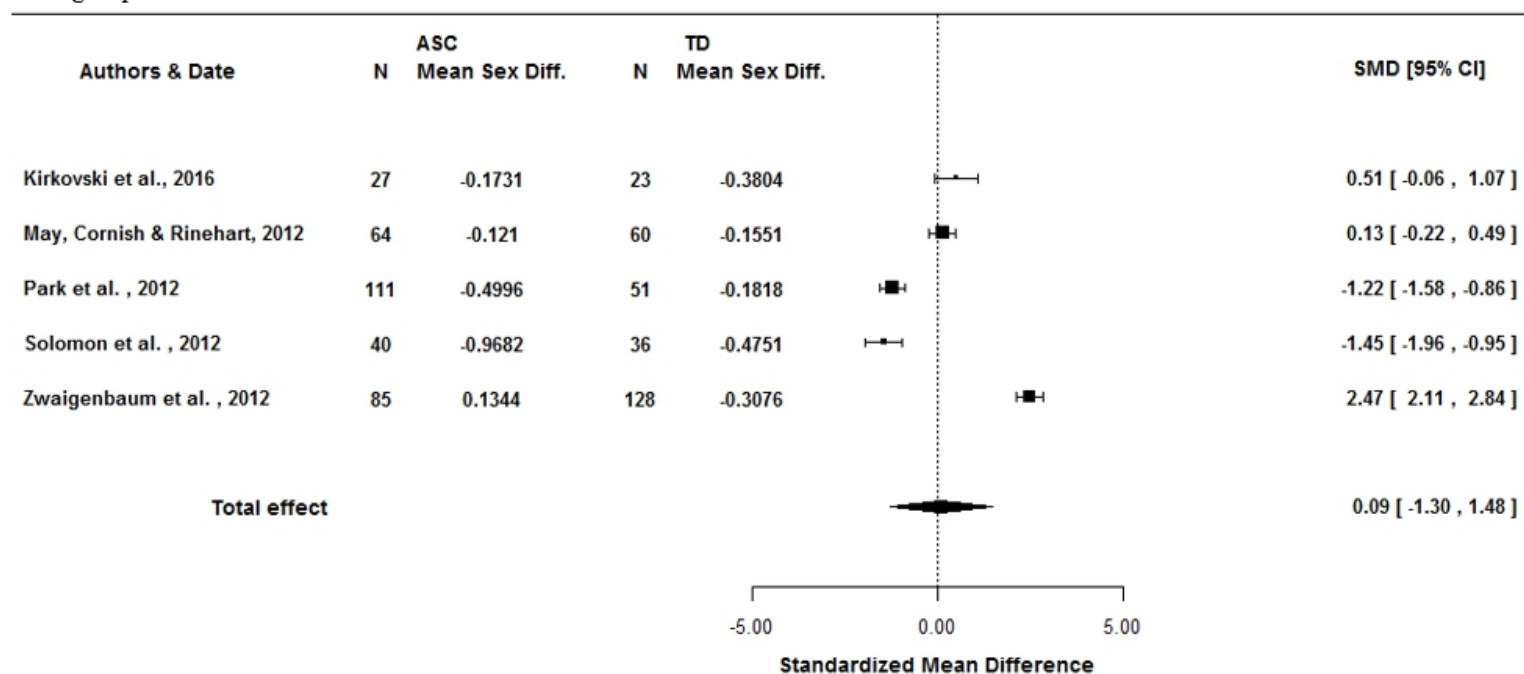


Figure 5. Forest plot of standardised mean differences (SMD) for RRBIs in each study and total SMD from all studies, drawn in R using 'metafor' package (Viechtbauer, 2010; R Foundation for Statistical Computing, Vienna, Austria). Central rectangle indicates mean effect; lines indicate 95% confidence intervals. Negative effects indicate smaller sex/gender differences in ASC groups than in TD groups; positive effects indicate larger sex/gender differences in ASC groups than in TD groups. If lines cross the y axis, effect is not significant. Rectangles indicate the effect size (SMD) in each study, with the size of the rectangle indicating the 'weight' of the study (determined by the sample size and the

precision of the confidence intervals). The diamond indicates the average effect across all studies, with the width of the diamond indicating the confidence intervals of the effect. ASC = Autism Spectrum Condition group; TD = typically developing group; CI = confidence interval.

Table 5

*Sex/gender differences in IQ for ASC and TD groups*

Authors (date)	Test used	Age of participants	ASC			TD		
			Female (SD)	Male (SD)	SMD [95% CI]	Female (SD)	Male (SD)	SMD [95% CI]
Bolte, Duketis, Poustka & Holtmann (2011)	WISC Non-Verbal IQ	Child/ Adolescent	98.60 (9.80)	99.80 (11.30)	-0.11 [-0.65, 0.43]	102.30 (12.80)	104.70 (13.30)	-0.18 [-0.71, 0.35]
Goddard, Dritschel & Howlin (2014)	Wechsler Full-Scale IQ	Child/ Adolescent	107.40 (13.50)	104.30 (12.40)	0.23 [-0.57, 1.03]	106.00 (11.10)	106.60 (11.20)	-0.05 [-0.85, 0.75]
Harrop, Green & Hudry (2016)	MSEL	Child	27.12 (10.27)	27.20 (10.92)	0.91 [0.13, 1.69]	23.35 (7.86)	22.50 (8.05)	0.10 [-0.67, 0.87]
Holt et al. (2014)	Wechsler Full-Scale IQ	Adolescent	96.44 (11.68)	108.42 (19.47)	-0.68 [-1.29, -0.07]	110.55 (12.66)	112.3 (11.57)	-0.14 [-0.76, 0.48]
Kirkovski et al. (2016)	KBIT-2	Adult	107 (14.48)	112.08 (14.37)	-0.34 [-1.10, 0.42]	113 (11.71)	112.45 (16.20)	0.04 [-0.78, 0.86]
Lai et al. (2012)	Wechsler Full-Scale IQ	Adult	114.10 (15.50)	113.70 (15.10)	0.03 [-0.46, 0.52]	119.70 (8.40)	116.30 (11.80)	0.33 [-0.17, 0.82]
Lemon, Gargaro, Enticott & Rinehart (2011)	Wechsler Full-Scale IQ	Child/ Adolescent	97.30 (16.74)	91.68 (18.40)	0.31 [-0.52, 1.14]	107.00 (10.72)	108.00 (11.00)	-0.09 [-0.96, 0.78]
May, Cornish & Rinehart (2012)	Wechsler Full-Scale IQ	Child	96.19 (12.62)	97.38 (9.01)	-0.11 [-0.60, 0.38]	106.50 (11.25)	108.43 (11.99)	-0.16 [-0.67, 0.34]

Oswald et al. (2016)	KBIT-2	Adolescent	107.64 (18.13)	112.11 (11.67)	-0.29 [-1.00, 0.41]	108.79 (16.80)	110.61 (10.60)	-0.13 [-0.83, 0.57]
Park et al. (2012)	LIPS	Child	92.00 (25.61)	93.34 (23.67)	-0.06 [-0.54, 0.43]	123.96 (11.37)	121.68 (9.11)	0.22 [-0.33, 0.77]
Sedgewick et al. (2015)	Wechsler Full-Scale IQ	Adolescent	81.17 (11.50)	78.40 (11.26)	0.31 [-0.52, 1.13]	76.54 (10.25)	76.54 (10.25)	0.00 [-0.82, 0.82]
Solomon et al. (2012)	Wechsler Full-Scale IQ	Child/ Adolescent	104.20 (15.29)	103.95 (16.87)	0.02 [-0.60, 0.64]	113.26 (10.23)	121.65 (11.01)	-0.77 [-1.45, -0.10]
Zwaigenbaum et al. (2012)	Mullen – Receptive Language Subscale	Child	40.20 (13.00)	41.90 (13.40)	-0.13 [-0.60, 0.35]	55.00 (9.60)	51.50 (10.50)	0.35 [0.09, 0.61]

Note. CI = confidence interval; WISC = Wechsler Intelligence Scales for Children; LIPS = Leiter International Performance Scale; KBIT-2 =

Kaufman Brief Intelligence Test – Second Edition; MSEL = Mullen Scales of Early Learning

Figure 6

Meta-analysis of studies comparing differences in sex/gender variation in IQ between ASC and TD groups

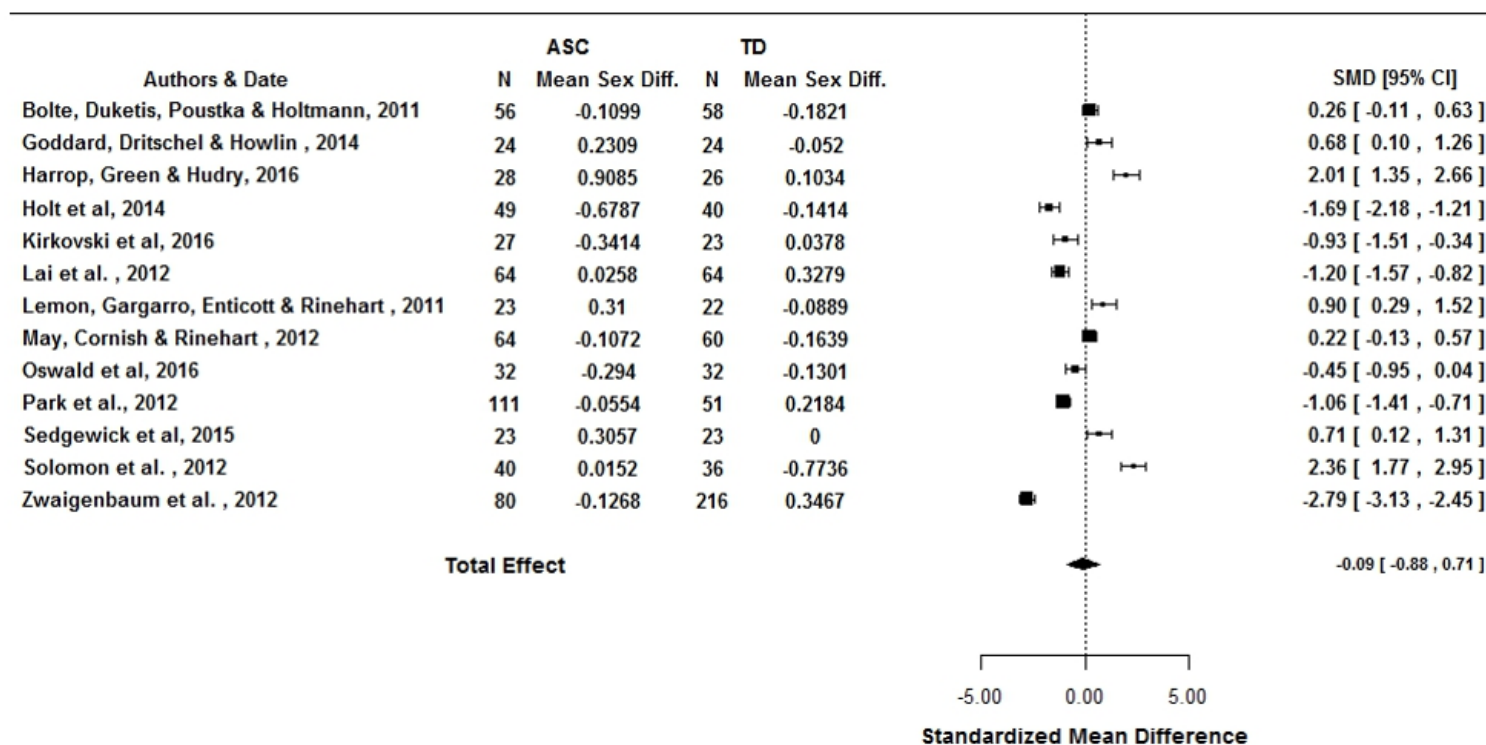



Figure 6. Forest plot of standardised mean differences (SMD) for IQ in each study and total SMD at each level of moderator 'Age', drawn in R using 'metafor' package (Viechtbauer, 2010; R Foundation for Statistical Computing, Vienna, Austria). Central rectangle indicates mean effect; lines indicate 95% confidence intervals. Negative effects indicate smaller sex/gender differences in ASC groups than in TD groups; positive effects indicate larger sex/gender differences in ASC groups than in TD groups. If lines cross the y axis, effect is not significant. Rectangles indicate the effect size (SMD) in each study, with the size of the rectangle indicating the 'weight' of the study (determined by the sample size and the precision of the confidence intervals). The diamond indicates the average effect across all studies, with the width of the diamond

indicating the confidence intervals of the effect. ASC = Autism Spectrum Condition group; TD = typically developing group; CI = confidence interval.

## “Putting on My Best Normal”: Social Camouflaging in Adults with Autism Spectrum Conditions

Laura Hull<sup>1,6</sup>  · K. V. Petrides<sup>2</sup> · Carrie Allison<sup>3</sup> · Paula Smith<sup>3</sup> · Simon Baron-Cohen<sup>3</sup> · Meng-Chuan Lai<sup>3,4,5</sup> · William Mandy<sup>1</sup>

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**Abstract** Camouflaging of autistic characteristics in social situations is hypothesised as a common social coping strategy for adults with autism spectrum conditions (ASC). Camouflaging may impact diagnosis, quality of life, and long-term outcomes, but little is known about it. This qualitative study examined camouflaging experiences in 92 adults with ASC, with questions focusing on the nature, motivations, and consequences of camouflaging. Thematic analysis was used to identify key elements of camouflaging, which informed development of a three-stage model of the camouflaging process. First, motivations for camouflaging included fitting in and increasing connections with others.

Second, camouflaging itself comprised a combination of masking and compensation techniques. Third, short- and long-term consequences of camouflaging included exhaustion, challenging stereotypes, and threats to self-perception.

**Keywords** Autism · Camouflaging · Coping · Sex · Gender · Social adaptation

### Introduction

Autism Spectrum Conditions (ASC)<sup>1</sup> are atypical developmental conditions characterised by impairments in social interaction and communication, alongside unusually restricted/repetitive behaviours and interests, need for sameness, and atypical sensory processing (APA 2013). ASC is generally viewed as dimensional, with traits found amongst the general population and a specified cut-off point, when present with concurrent functional impairments, used to identify the clinical diagnosis (Baron-Cohen et al. 2001; Constantino 2011). One behaviour associated with ASC that has recently attracted interest is the development of camouflaging or coping strategies for use in social situations (Attwood 2007; Gould and Ashton-Smith 2011; Kopp and Gillberg 2011; Lai et al. 2011; Wing 1981). These strategies may include hiding behaviours associated with their ASC, using explicit techniques to appear socially competent, and finding ways to prevent others from seeing their social

Meng-Chuan Lai and William Mandy are joint senior authors for this paper.

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✉ Laura Hull  
laura.hull.14@ucl.ac.uk

<sup>1</sup> Research Department of Clinical, Educational & Health Psychology, University College London, London, UK

<sup>2</sup> London Psychometric Laboratory, University College London, London, UK

<sup>3</sup> Autism Research Centre, Department of Psychiatry, University of Cambridge, Cambridge, UK

<sup>4</sup> Child and Youth Mental Health Collaborative at the Centre for Addiction and Mental Health and The Hospital for Sick Children, Department of Psychiatry, University of Toronto, Toronto, ON, Canada

<sup>5</sup> Department of Psychiatry, National Taiwan University Hospital and College of Medicine, Taipei, Taiwan

<sup>6</sup> Department of Psychology, University College London, 26 Bedford Way, London WC1H 0AP, UK

<sup>1</sup> We use the term ‘Autism Spectrum Condition’ (ASC) when referring to a diagnosis of Autism Spectrum Disorder, to be respectful to those on the spectrum who feel that the term ‘disorder’ is stigmatising, whereas ASC is compatible with the presence of both the strengths and difficulties of people on the spectrum.



difficulties. In this paper we will refer to these behaviours as 'camouflaging'.

While many neurotypical people, of all genders, manage the way others perceive them in social situations (Izuma et al. 2011), research suggests that individuals with ASC have a reduced ability to do so (Cage et al. 2013). However, the research in this area has focused on the manipulation of typical social behaviours, rather than how individuals with ASC may want and be able to adapt their ASC-related characteristics. Camouflaging is likely to exist on a spectrum (similar to autistic traits) in those who have an ASC diagnosis and those who are subclinical. However, self-reported evidence suggests possible categorical differences between autistic and non-autistic camouflaging. For instance, camouflaging by ASC individuals has been reported as extremely effortful and challenging to one's identity (Bargiela et al. 2016), unlike ordinary reputation management in typically developing individuals.

Camouflaging has also been proposed as an explanation for the missed or late diagnosis of females with ASC, as part of the female phenotype or behavioural presentation (Gould and Ashton-Smith 2011; Kirkovski et al. 2013; Lai et al. 2015). Amongst clinical samples, male to female gender ratios for ASC diagnosis are generally around 4:1 (Fombonne 2009), but when active case ascertainment is used within the general population, the ratio lowers to around 3:1 (Sun et al. 2014). This discrepancy suggests that there are biases that work against females with ASC receiving accurate, timely diagnoses from clinical services. Females are less likely to receive a diagnosis of ASC than males with similar levels of autistic traits (Dworzynski et al. 2012; Russell et al. 2011), and those who receive a diagnosis on average are more likely than males receiving the same diagnosis to be older and have more additional needs, including increased intellectual disability (Shattuck et al. 2009) and behavioural-emotional challenges (Duvekot et al. 2016). Clinical experience suggests that females with ASC may be more likely than males with ASC to have been previously misdiagnosed with other mental health conditions, such as personality disorders or eating disorders (Lai and Baron-Cohen 2015; Mandy and Tchanturia 2015).

In addition to camouflaging, there are other gender differences in autistic characteristics which may contribute to late diagnosis or misdiagnosis of females. While few significant quantitative sex differences in the core symptoms have been found (Hull et al. 2016; Lai et al. 2015; Mandy et al. 2012; Van Wijngaarden-Cremers et al. 2014), comparisons of associated characteristics have shown differences between the female and male presentations (Kreiser and White 2014; Rivet and Matson 2011). For instance, males with ASC are more likely

to experience externalising difficulties such as hyperactivity and conduct problems, whereas females with ASC are more likely to experience internalising problems such as anxiety and depression (May et al. 2012; Oswald et al. 2016).

These 'qualitative' differences between male and female presentation, including camouflaging behaviours, need to be included in measures used to assess ASC, as sex differences at a nosological level are likely to have an impact on diagnosis (Lai et al. 2015). Current diagnostic practices focus on the core ASC characteristics that have been historically established from the behavioural presentation in males, and so do not necessarily reflect the areas in which females with ASC may display different behaviours to males. As a result, current assessments of females with ASC are restricted to the areas in which females are most similar to males, and those females who do not meet the male-typical behavioural descriptions are likely to be missed (Van Wijngaarden-Cremers et al. 2014). Diagnostic biases may lead to biased sampling in studies of sex differences in ASC, such that only male-typical ASC behaviours are expected, and therefore only these behaviours are found when looked for. It has hence been argued that diagnostic assessments of ASC should include female-typical behaviours to more accurately assess ASC prevalence and characteristics across genders (Kreiser and White 2014).

Camouflaging in certain settings may lead to the perception that individuals function well and do not experience any problems, even though those individuals still experience difficulties as a result of the interaction of their ASC and the context. For example, it is suggested that girls with ASC may mimic other socially successful individuals to give the impression that they too are socially successful, but when placed in unknown environments they are not prepared for, they struggle to socialise (Attwood 2006). This may reflect both a stronger motivation to mimic, and itself be the result of a stronger motivation to 'systemize' social behaviour, than is seen in males with ASC. Teachers or clinicians may therefore be unaware of the difficulties being faced by girls and women with ASC, whereas family members may see their loved one in a range of situations and so realise the extent of their difficulties. Alternatively, women who receive an ASC diagnosis later on in life may have spent years feeling different and attempting to minimise this difference, until their children receive a diagnosis and they recognise the symptoms within themselves (Holliday Willey 2015).

There is a variety of anecdotal evidence of camouflaging amongst women with ASC. For instance, Liane Holliday Willey describes how she spent her life pre-diagnosis 'pretending to be normal', yet knowing that something was different about her (Holliday Willey 2015). In case studies of

girls with ASC, researchers have suggested that the use of social imitation strategies may lead to missed, late, or questioned diagnoses (Kopp and Gillberg 1992). Essentially, social imitation may be a form of acting, whereby girls with undiagnosed ASC may be coping without receiving a diagnosis or even needing a diagnosis because their acting is relatively successful. Success here may be defined as simply not having overt functional impairments or raising concerns of teachers or other professionals, even though under the surface or behind maintaining such appearances, females may report high levels of subjective stress, anxiety and exhaustion, and a need to withdraw from social interaction to 're-set'. These observations have not yet been systematically tested, despite extensive interest in gender differences in ASC and the female phenotype (Gould and Ashton-Smith 2011; Kopp and Gillberg 1992; Lai et al. 2015; Robinson et al. 2013).

Individuals with ASC also display significant variation in their outcomes across the lifespan, especially concerning their social functioning. Some adults with ASC form friendships and relationships, and have fulfilling careers that enable them to remain independent (Farley et al. 2009; Strunz et al. 2016). Others, however, struggle to maintain social relationships and may remain unemployed, despite having the motivations and capabilities to work (Baldwin and Costley 2015; Shattuck et al. 2012). While some of this variation is due to individual differences in cognitive abilities, language ability, and personal preference (Howlin et al. 2000; Shattuck et al. 2012; Van Bourgondien et al. 1997), it is possible that an individual's ability to camouflage their ASC contributes to them achieving socially desirable outcomes. Individuals who are better able to camouflage their ASC characteristics might feel more able to make friends, improve their social support, and perform better in job interviews.

However, many individuals with ASC also report extensive anxiety and depression, especially those with average-to-high levels of IQ and language abilities (Lugnegård et al. 2011). Anecdotal evidence suggests that an individual's camouflaging can impact their mental health (Holliday-Willey 2015). Where camouflaging is unsuccessful, strenuous, or if the person feels forced to camouflage, it may be associated with high stress level, low mood and low self-esteem. In addition, the pressure to maintain successful camouflaging may lead to anxiety for individuals with ASC. Camouflaging is not necessarily a beneficial behaviour, and should not be regularly expected or encouraged for individuals with ASC, as this may risk increasing mental health problems. It is therefore important to study camouflaging in order to better understand the individual differences predicting long-term wellbeing and outcomes for individuals on the autism spectrum.

A small number of studies have recently emerged which directly examine social camouflaging behaviours in individuals with ASC. Tierney, Burns, and Kilbey (2016) interviewed ten adolescent girls with ASC about their experiences of camouflaging, and revealed some common themes including the uncertain, exhausting nature of the social environment; the desire to make friends which motivated camouflaging attempts; and using explicit techniques to mask ASC-related difficulties. Similar themes were also found during qualitative interviews with late-diagnosed women with ASC (Bargiela et al. 2016). In particular, the idea of pretending to be normal, which could be achieved through both learned and automatic strategies, and the extensive costs of such strategies, were identified. Recently, some empirical operationalisation of camouflaging behaviours in both children and adults with ASC has also been developed. Behavioural observations suggest that girls camouflage their social difficulties (e.g. by staying in close proximity to peers and weaving in and out of activities) to a greater extent on the playground than boys, and therefore are less likely to be identified as struggling socially (Dean et al. 2016). Camouflaging, operationalised as the discrepancy between (a) interpersonal behavioural presentation and (b) self-reported autistic traits and objectively measured social cognitive abilities, was found to be on-average higher in women with ASC than in men with ASC, although was associated with more symptoms of depression in men (Lai et al. 2016). These important initial studies suggest that camouflaging is a real and meaningful experience in the lives of people with ASC, and directly impacts on their social functioning and mental wellbeing.

Despite these encouraging first steps, key questions about camouflaging still need to be answered, such as how common camouflaging is within the ASC population, whether it varies across the lifetime, and whether individual differences in camouflaging are related to long-term outcomes in functioning, achievement and quality of life. In addition, the majority of those diagnosed with ASC identify as male, and a significant number of ASC individuals experience non-binary gender identities (Glidden et al. 2016; Kim et al. 2011). It is therefore important to examine camouflaging behaviours across all genders, as research so far has focused on female experiences.

Most importantly, studies of camouflaging in ASC cannot progress until a conceptual model of camouflaging has been produced, so that subsequent research has strong theoretical grounding. Such a model is best developed from a qualitative analysis of the camouflaging experiences of individuals with ASC. This will ensure that the construct of camouflaging reflects the real-life experiences of individuals with ASC rather than the preconceptions of researchers or clinicians, and that our understanding of camouflaging is representative of a broad range of individuals with

**Table 1** Demographic characteristics of participants and whether they reported camouflaging

	Female	Male	Other gender
N	55	30	7
Age (mean years)	40.71 (SD 14.14)	48.03 (SD 16.62)	40.71 (SD 14.29)
Age (range)	18–68	22–79	27–69
Age at diagnosis (mean years)	36.98 (SD 14.21)	41.03 (SD 18.08)	32.67 (SD 9.25)
Camouflage? (yes/no)	51/4	28/2	7/0
Nationality			
British	30	17	4
North American	12	3	1
Western European	7	6	2
Other	6	4	0

Three male participants reported their natal sex as female. All participants who identified their gender as 'Other' reported their natal sex as female

ASC. Inductive (i.e. data-driven) research resulting in a comprehensive model of the camouflaging process will enable hypothesis generation and form the basis of measurement development to further explore camouflaging quantitatively.

The present qualitative study examined camouflaging in a large sample of adults of all self-identified genders who had been diagnosed with ASC, using internet-based survey and thematic analysis. Emphasis was placed on the motivations for camouflaging, techniques used, the impact that camouflaging has for the individual, and their overall attitudes to camouflaging. The aim of the study was to derive a conceptual model of camouflaging to inform future research.

The following research questions were addressed:

1. What is camouflaging?
2. What are the techniques used and what do people with ASC think camouflaging is?
3. Why do people camouflage their ASC?
4. What are the consequences of camouflaging?

## Methods

### Participants

Participants were 92 adults of 15 different nationalities (55% British). They were eligible to take part in the study if they were over the age of 16 years and had received a DSM-IV or DSM-V diagnosis from a psychiatrist or clinical psychologist in a recognized specialist clinic of an ASC, including Autism/Autistic Disorder, Asperger Syndrome/Asperger's Disorder, Autism Spectrum Disorder, Atypical Autism, and Pervasive Development Disorder Not Otherwise Specified. Participants were recruited via the Cambridge Autism Research Database (CARD) and

through adverts placed on social media. Whilst it was not possible for this study to independently verify the diagnostic status of participants, several measures were taken to check diagnostic status and establish the generalisability of findings from this sample. Participants were asked to report whether they had received an ASC diagnosis (and if so, at what age and from which type of healthcare professional) or whether they were self-diagnosed. Those who reported self-diagnosis, or who reported receiving an ASC diagnosis from someone other than a medical professional, clinical psychologist, or healthcare team, were excluded from current analysis ( $n=3$ ). Demographic characteristics of participants are included in Table 1. Participants were asked to identify their gender as 'female', 'male' or 'other', and give more details if they wished.

### Materials

A newly designed questionnaire of camouflaging was developed by the researchers, in consultation with other experts in ASC, including clinicians, researchers, and adults with ASC. The questionnaire included 23 closed and 20 open questions, and examined participants' motivations for camouflaging, the characteristics of their camouflaging experiences, the consequences of camouflaging (positive and negative), and their attitudes towards camouflaging (see online Appendix 1). Closed questions were developed from predicted behaviours and observations raised during the development process, although participants were able to give additional detail to their answers if they wished. Open questions were designed to elicit new insights from participants and identify experiences not anticipated by the researchers.

Demographic information about the participants, including details of their ASC diagnosis, was also obtained. Other measures, including those of quality of life, social anxiety,



and depressive symptoms, were administered, but not included in the current analysis.

### Procedure

Participants were emailed an online link to 'a study looking at experiences of coping behaviours in social situations' (which was hosted by Qualtrics) or followed a link posted on social media. They were reminded that they could withdraw at any point and were under no obligation to answer any question. Participants completed the survey at their leisure and were able to stop and start their responses as they chose, to minimise stress or discomfort from completing the survey.

Early in the questionnaire after demographic data had been ascertained, participants were asked the following question: "Have you ever had the experience of 'camouflaging' your autism? A reminder: in this survey we use the term 'camouflaging' to refer to 'coping skills, strategies, and techniques that function to "mask" features of ASC during social situations.'" Those who responded 'no' were directed to the end of the questionnaire, where they could leave their thoughts on camouflaging if they wished. These responses were included in the final analysis. Those who responded 'yes' completed the full questionnaire. Four females (7% of total number of females) and two males (6% of total males) reported that they had never camouflaged their ASC in social situations. All seven participants who identified their gender as 'Other' reported camouflaging their ASC. Responses were saved securely on the Qualtrics server in an anonymised format.

Ethical approval for this study was obtained from the University of Cambridge Psychology Research Ethics Committee, reference number Pre.2015.036. Informed consent was obtained from all individual participants included in the study.

### Analysis

Analysis followed the six phases of thematic analysis recommended by Braun and Clarke (2006) with the aim of identifying patterns of information within the data which answered the research questions. This inductive (i.e., data driven) analytic approach was chosen because it does not rely on a rigid theoretical framework for interpretation, and so enables researchers to examine alternative perspectives and identify new information within developing areas of psychology (Willig 2013). Guidelines for good qualitative research (Barker and Pistrang 2005; Elliott et al. 1999; Ritchie et al. 2014) were followed to ensure that interpretations were credible and could be generalised beyond the existing sample. A consensus approach was taken with data extracts read thoroughly by one author (LH) and

codes addressing the research questions identified. Initial codes were audited by an independent researcher to confirm that interpretations reflected the data accurately. These codes were then checked by the two senior authors (MCL and WM), and the finalised set of codes was grouped into themes and subthemes. All authors discussed and refined themes until a consensus was reached. Member validation was used as a further credibility check: themes and subthemes were sent to six participants (five female, one male) who had expressed interest in the findings to ensure these accurately reflected their experiences.

### Results

Seven themes, comprising 16 subthemes, were clustered into three stages of the camouflaging process, as detailed in Fig. 1. Motivations (Assimilation and "To know and be known") describe the reasons why respondents camouflaged their ASC, including the aims they hoped to achieve as a result. What is Camouflaging? (Masking and Compensation) describes the concept of camouflaging itself, including the techniques used. Finally, the short- and long-term consequences of camouflaging are described through the themes "I fall to pieces", "People have a stereotyped view", and "I'm not my true self". Names of themes and subthemes are taken directly from quotations from respondents. The number of participants who referenced each theme at least once is displayed in Table 2.

#### Motivations for Camouflaging

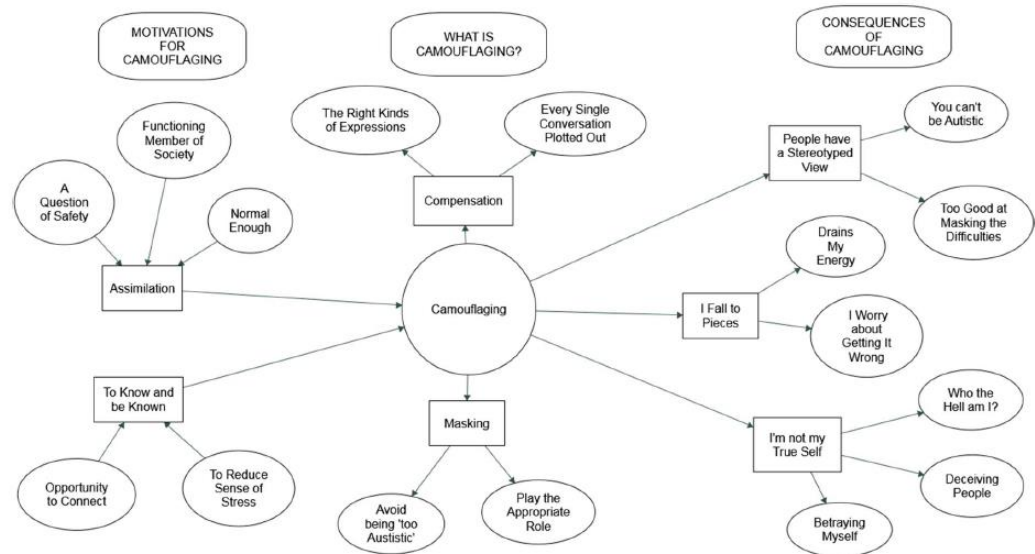
##### *Assimilation: "Hide in Plain Sight"*

Respondents described wanting to camouflage in order to 'blend in with the normals'. Most respondents reported a social expectation from the general population that individuals with ASC need to change in order to be accepted by others. Respondents' social and communication difficulties, and their unique behaviours and interests, meant that they stood out from the crowd during social situations. It was felt that the general population viewed this as unacceptable, and so respondents felt a pressure to change their behaviours in order to seem 'normal enough'.

[I camouflage] to reduce the threat of feeling uncomfortable through being unable to measure up to social expectations. (Male, 62)

I don't want to draw attention to myself by appearing to be different. (Female, 30)

However, a few respondents suggested that their motivations to camouflage were similar to those of the general



**Fig. 1** Thematic map of the three stages (motivations, camouflaging, and consequences) of the camouflaging process. Themes are indicated by rectangles; subthemes by ovals

**Table 2** Number of participants who referenced each theme

Theme	Number of participants		
	Female (n = 55)	Male (n = 30)	Other gender (n = 7)
Assimilation: "hide in plain sight"	49	20	7
"To know and be known"	42	24	5
Compensation: "to exceed what nature has given"	45	22	7
Masking: "I'm hiding behind what I want people to see"	38	18	7
"I fall to pieces"	44	21	7
"People have a stereotyped view"	32	6	4
"I'm not my true self"	31	15	3

population; camouflaging was simply seen as the way in which everyone tries to fit in or hide less desirable aspects of their personality:

Most neurotypicals are camouflaging nearly all the time they are in public. (Male, 79)

A more pragmatic aspect of this motivation was the desire to obtain jobs and qualifications, which respondents felt were less accessible when they were more visibly 'autistic'. Many respondents described how they would not have achieved as much had they been more open about their ASC characteristics. Camouflaging during these situations

was thought to improve employment opportunities, and so enable them to become a 'functioning member of society'.

I'm pretty sure no-one would ever hire me if I didn't camouflage in job interviews. (Other, 27)  
 Camouflaging helps to survive in school and college and it is important for keeping jobs. (Female, 27)

The desire for assimilation was also prompted by concerns for their own safety and wellbeing. Many described being ostracised, verbally or emotionally attacked, and some even reported physical assaults when they had not camouflaged their ASC:

When I was younger and more obviously odd and strange I was thought of as stupid and also badly physically and mentally bullied. I also lost employment. I want to avoid the bullying mostly. I have even been spat at in the street. (Female, 49)

Most attributed this to their perceived differences compared to others, and used camouflaging techniques to minimise these differences and hence reduce the threat. This was particularly the case when describing their experiences in childhood and adolescence; respondents often reported that relations with others improved as they got older and were better able to camouflage their ASC.

If I had known how to camouflage earlier, perhaps I wouldn't have been such an outcast as a child. (Other, 41)

#### *"I Want to Know and Be Known"*

The other key motivation for camouflaging was to increase connections and relationships with others. Due to their inherent social difficulties, many respondents reported struggling to make friends and form romantic attachments, despite this being a strong desire. Camouflaging was seen as one way to overcome the initial obstacles to connection and allow for future relationships to develop.

Many respondents wanted to be accepted by others and be able to socialise, but recognised that they lacked the skills needed to make small talk, interact comfortably with strangers, and relax in social situations. This limited their ability to get to know people better. As will be discussed further in the theme 'Compensation', camouflaging offers solutions to some of these issues. The payoffs in terms of easier social interaction were a strong motivation for many respondents to camouflage their ASC with others. However, several respondents felt camouflaging was only necessary for the initial stages of a friendship or relationship; once a connection was established, the respondent felt more comfortable showing their 'true' ASC characteristics.

I know it is necessary when I am first getting to know someone. After I have known them for a while and they know I have Asperger's and they are accepting of my quirks, then I can let my guard down more. Connections have to be made initially on neurotypical terms. Then, hopefully, on my terms as well. (Female, 46)

For some, the risk of failure and associated embarrassment created severe anxiety during social interactions; by camouflaging and using structured techniques, respondents could reduce some of this uncertainty and so were more confident in their ability to socialise. Respondents felt that camouflaging would lead to success in a variety of social

situations, when compared to their default behaviours or responses.

It enables me to be with other people in a way that is relatively comfortable for me and for them. I avoid looking like a socially clumsy idiot. It avoids the embarrassment and awkwardness of getting things wrong. (Female, 56)

#### **What is Camouflaging?**

##### *Masking: "I'm Hiding Behind What I Want People to See"*

Masking encompasses the aspects of camouflaging that focus on hiding one's ASC characteristics and developing different personas or characters to use during social situations. Both of these emphasise a distinction between the respondent's 'true' or 'automatic' behaviours, and what they present to the rest of the world.

Camouflaging was partly performed through suppressing, hiding, or otherwise controlling behaviours associated with ASC that were seen as inappropriate in the situation. The extent to which this happened could vary depending on who the person was with; camouflaging tended to occur less often with close friends and family members, although some respondents described camouflaging at all times.

Respondents described attempting to minimise their self-soothing or 'stimming' behaviours, and their responses to sensory overstimulation, in order to make their condition less obvious to others. These techniques included using objects as 'props' to meet sensory needs in a subtle way, and giving themselves regular excuses to leave overstimulating environments and calm down.

I prevent myself from doing any particularly visible or otherwise noticeable stims: I still find myself doing things like shaking my leg repeatedly without noticing, but don't make any noises people would think are weird, don't full-body shake (like with the leg but... all of me), or do any finger movements or tapping etc. that would annoy people. (Female, 20)

Masking enabled respondents to present a different identity to the outside world, one that covered up those parts of themselves they were not happy with. The combination of controlled behaviour and appropriate conversation produced through camouflaging was often described as essential during social interactions, even though this meant concealing one's actual personality.

I don't think I'll ever completely stop wearing the mask. It's a defence mechanism really. It is easier to have people you're friendly with, than taking



the mask off[f] and revealing the real broken you. (Female, 18)

In some cases, this went as far as portraying an entirely different character, and several respondents likened it to acting or performing a role, complete with costumes. The character or aspects of the role could change across different situations:

I camouflage by putting on a character... I treat my clothes rather like costumes, and certain items of clothing help me to uphold certain personality characteristics of which character I am on that occasion. I have a repertoire of roles for: cafe work, bar work, uni, various groups of friends, etc. They are all me at the core, but they are edited versions of me, designed to not stand out for the 'wrong' reasons. (Female, 22)

One way to easily identify the appropriate role to play was to mimic the behaviours of others during a social interaction. Behaviours could be copied directly from the person in front of them, or could be identified and learned from observing others interacting, and even from watching television and films. Some respondents went as far as to copy clothing style, mannerisms, and even interests from others.

I try to copy socially successful people by trying to imitate their speech and body language and trying to understand their interests. (Male, 71)

#### *Compensation: "To Exceed What Nature has Given"*

The other aspects of camouflaging centre around developing explicit strategies to meet the social and communication gaps resulting from an individual's ASC, which we call compensation. These camouflaging techniques include specific non-verbal communication strategies and guidelines for successful conversations with others. Respondents often described these techniques as 'rules' or expectations from others that had to be met, even if they themselves felt these rules were not necessary.

Explicit, compensatory strategies were reported by many respondents as a vital way to improve non-verbal communication with others. These strategies aimed to help the individual perform behaviours used in typical social encounters, which they would not necessarily perform naturally. Respondents described how these camouflaging techniques required intensive monitoring of the way they presented themselves, in order to ensure they were being performed as correctly as possible.

Forcing and maintaining appropriate eye contact, or attempting to look as close to another's eyes as possible, was a common compensatory technique reported. Respondents also made an effort to display facial expressions of

emotion or interest, even if they didn't feel this inside. Different expressions were identified as important for different situations, and so many respondents described keeping a mental list of how to behave depending where they were.

I look in people's eyes when I first meet them/or in formal/professional situations even though I wouldn't naturally, because I know you're supposed to. (Female, 26)

I try to look people in the eye and make faces that fit the situation. (Other, 27)

Many respondents noted that their preferred levels of emotional expression and body language did not match those of others around them, and so over-emphasised these behaviours in order to communicate better. This included non-verbal and verbal signs of interest in the interaction, which were also used to encourage others to continue speaking and so take the pressure off the ASC individual to respond appropriately.

My autistic lack of non-verbal signals are read as hostility, arrogance or indifference by people, so I have to act the good will that I genuinely feel. (Female, 45)

I'm not good at knowing when it's my turn and I also tend to just blurt out things or keep talking when I should have stopped, so I prep myself always in social situations to have a reminder or tag or internal buzzer about not speaking too much and trying to do more listening, nodding, agreeing. (Female, 49)

In addition to these non-verbal techniques, respondents reported developing rules or guidelines to compensate for some of the social difficulties they experienced during conversations. These were more generalised and so could be prepared ahead of time and applied to different situations. These camouflaging strategies were used to help the ASC individual get through 'small talk' or more in-depth conversations with minimal stress, and to make the chat more enjoyable for their social partners.

One rule was to ask questions of the other people. Explanations for this varied between respondents, but included minimising the amount of time they had to speak, giving them more time to prepare things to say, and ensuring the ASC individual did not take over the conversation by talking about themselves or their own interests.

I've recently tried to institute a rule about asking more "you" questions - how did that make you feel, what did you do next, what do you think about a given thing - instead of "me" or "I" statements. (Male, 29)

My issue is talking too much or saying the wrong things. I tend to think of one or two questions to ask the person and most people are so happy just

to talk about themselves that it stops them shining a spotlight on me. I find asking questions is the best deflection and camouflage ever. (Female, 49)

Respondents were often aware that talking only about themselves and their interests was not socially acceptable and so developed strict rules to control their self-focused talk. For some, camouflaging also involved not divulging personal details about themselves, whether to protect themselves from being taken advantage of, or to maintain privacy.

I say as little about myself as possible as the more I say, the more likely it is that I say something inappropriate OR give away too much information about myself which can then be used against me. (Other, 31)

I remain silent when I might otherwise have spoken, knowing that I can't always tell whether or not my comments would be welcome. I make generic comments rather than offering specific ones that might reveal my more unusual traits. (Male, 29)

Respondents also described spending time before an interaction to prepare topics of conversation, including questions to ask, anecdotes to relate, and potential responses to others. These made them feel more in control of the interaction, and reassured them that they would have structured 'scripts' to follow rather than having to spontaneously 'chat':

I usually also think up stories and how whole conversations might go before I have them so I have responses practiced as well as potential things to say if the conversation 'dries up'. (Female, 20)

However, it is important to emphasise that not all respondents developed such structured rules for conversation; some simply had the goal of speaking as little as possible in order to get out of the interaction quickly.

In these social situations, I do not talk about anything of interest to me, I avoid talking much and just pretend to be interested in what people are saying. (Female, 42)

### Consequences of Camouflaging

#### *"I Fall to Pieces"*

By far the most consistent consequence of camouflaging described by respondents was exhaustion. Camouflaging was frequently described as being mentally, physically, and emotionally draining; requiring intensive concentration, self-control, and management of discomfort. The longer

a camouflaging session continued, the harder it became to maintain the intended level of camouflaging. Many respondents reported needing time to recover after camouflaging, where they could be alone and release all of the behaviours they had been suppressing.

It's exhausting! I feel the need to seek solitude so I can 'be myself' and not have to think about how I am perceived by others. (Other, 30)

In addition to this exhaustion, after a camouflaging session was over some respondents would experience extreme anxiety and stress. Respondents felt significant pressure, whether from themselves or others, to camouflage successfully, but many were uncertain of how effective their camouflaging strategies were. Twenty-one respondents (10 male, 11 female) reported being unsuccessful in their camouflaging attempts or reported that they had not achieved the outcomes they intended.

I try to ask them about the things they like, question after question, to keep conversation going but sometimes it doesn't work and they leave me. (Female, 27)

Camouflaging therefore often involved a constant monitoring of the situation, as if training oneself in self-monitoring, self-awareness, and monitoring others' reactions, both during and after the interaction occurred, which induced stress and even greater anxiety.

My head will be racing as if I'm interpreting another language. I will be incredibly anxious. It's like studying for an exam, constantly on edge trying to predict what others will say and do. (Female, 49)

I hate it. I go over and over and over what they said and what I said. Did I understand them correctly, did I respond appropriately, did I make a gaffe? Have I offended anyone? (Female, 45)

In contrast, a minority of respondents reported feeling satisfied and relieved after camouflaging, particularly if they felt as though it went well. For these individuals, camouflaging was rewarding because it enabled them to achieve what they wanted with minimal effort, whether that was getting through a necessary social situation, or being able to make a connection with someone. Interestingly, 60% of those who reported feeling positive or relieved after camouflaging were male (n=9, compared to six females), in contrast to the majority female total sample.

Small sense of achievement and relief that it is over. (Male, 69)

I am glad that the camouflaging enables me to survive within myself and accomplish any necessary tasks. (Male, 62)



*"People Have a Stereotyped View"*

Many respondents felt that, because their camouflaging changed the way they presented themselves to others, they did not meet the stereotype of 'an autistic person' when they camouflaged. In many ways this was construed as positive, since it allowed them to get on in life, succeed in jobs and relationships, and achieve many of the aims they wanted. Some also reported that this enabled them to challenge commonly held views of autism, especially for women. By demonstrating good social skills and educating others about their conditions, respondents hoped to change the public perception of autism and make others more understanding.

People don't always realise that I have AS, more likely to be socially accepted, more likely to get a job. (Male, 28)

I feel that I'm showing the people I work with that autistic people can have people skills and be good role models (Female, 28)

Some female respondents (n=7) suggested that others were surprised that they had an ASC, since they differed so much from the public perception of an ASC man with high maths skills, poor eye contact, and uncommon interests.

So many people have a stereotyped view of what ASC looks like. They think people with AS are all geeky, and have little empathy and little insight. They think people with ASC bore on and on about their pet subject and make tactless remarks. They don't realise that women with ASC tend to internalise things much more and do have empathy and insight, and are very careful not to make hurtful remarks. (Female, 56)

However, there were also negative consequences to not appearing autistic to others. The most striking was that for some respondents their camouflaging, even if it was involuntary, resulted in a delay or questioning of their ASC diagnosis. Respondents reported that parents, teachers, and even clinical professionals refused to believe they could have an ASC, especially if they were female:

The amount of girls that aren't diagnosed because they are more likely to camouflage than boys is really bad. I went for so long without being diagnosed because they didn't know that I could pretend to be normal! (Female, 20)

In addition to this, respondents described failing to receive adequate support or allowances for their ASC difficulties, because these difficulties were often hidden behind the mask of camouflaging. Others would therefore

give them more responsibilities or expectations than the respondent was comfortable with, because of a perceived level of capability that did not always actually exist.

After beginning graduate school, a lot of issues arose because I was camouflaging to the point that my support needs weren't being met. So, in that instance, it was detrimental to camouflage. (Female, 24)

I am an SEN teacher and my boss doesn't know when I am camouflaging. Currently highly stressed because she keeps giving me more work and not realising the stress it is causing. (Female, 44)

For some respondents, this reflected the idea that camouflaging was not a conscious choice; they described wanting to control when and how they camouflage to a greater degree, in order to access support when they needed it:

People need to learn how to drop the camouflage when in situations such as medical assessments or dealing with support professionals otherwise they may be under assessed for support as they appear to be coping. (Female, 28)

For others, however, camouflaging was seen as a deliberate technique to avoid detection. Thus, increasing general awareness of camouflaging strategies by the public, and particularly by employers, was seen as 'outing' an ASC individual without their consent. These respondents feared that by giving others the tools to identify their camouflaging, the negative consequences they were trying to avoid would still happen.

If they [employers] can identify camouflaging, then they will "find us out" and reject us. (Female, 68)

*"I'm Not My True Self"*

The final consequence reported by respondents was that camouflaging affected their perception of themselves, in particular how they represented themselves to the outside world and their sense of authenticity. For many respondents, by camouflaging their 'true' or natural behaviours they were lying about who they were. This was often regretted by the respondents, who wanted to be happy as they were, but felt that the pressures of the typical social world meant this was not possible.

I don't care about being different, I like my differences (apart from things feeling really stressful and no confidence) but I don't want to deal with people's negative and sometimes evil reactions. I feel

like the weight of a black cloud is hanging on me having to be this fake version of me. (Female, 48)

In an extension of this, for some respondents their camouflaging behaviours contradicted the important role they attributed to ASC in shaping their identity. Despite feeling proud of their ASC diagnosis, and the community they were a part of, they still deliberately camouflaged the behaviours associated with this diagnosis. These individuals felt that by hiding their ASC characteristics, they were betraying the ASC community as a whole.

It's mentally exhausting constantly having to be something else, literally never being able to be myself, and kind of sad too I guess? I even stop myself doing certain tics and things automatically when I'm by myself and that kinda sucks, that I'm not even me on my own. I guess I'm letting down the side a bit by hiding my autism; I am very vocal about stigmas and stereotypes with mental illness, and do talk about my anxiety openly, so I don't know why autism is different. (Female, 20)

Some respondents felt that the relationships they formed through camouflaging were based on deception, and therefore the relationships themselves were false. This reinforced experiences of loneliness and isolation, as they felt no one truly knew them or understood them. Some also felt bad for deceiving their friends and even loved ones.

I feel sad because I feel like I haven't really related to the other people. It becomes very isolating because even when I'm with other people I feel like I've just been playing a part. (Female, 30)

I was married for 15 years and was camouflaging in high gear during that time... My husband would occasionally say to me that he wondered if I was really who I was. I think he would get glimpses of the real me. I didn't even know who the real me was... The marriage ended in divorce. (Female, 64)

The situations in which respondents camouflaged were so extensive for some, they felt that they were losing sense of who they truly were. Respondents often felt they were playing so many different roles, it was hard to keep track of their authentic sense of identity. This increased the anxiety and stress associated with camouflaging, as individuals lost a sense of grounding and security in who they were.

Sometimes, when I have had to do a lot of camouflaging in a high stress environment, I feel as though I've lost track of who I really am, and that my actual self is floating somewhere above me like a balloon. (Female, 22)

## Discussion

This study identified key themes underlying the motivations, techniques, and consequences associated with social camouflaging amongst adults with ASC. The vast majority of participants (male, female, and of other genders) reported camouflaging to some degree, although there was significant variation in individual experiences of camouflaging. The results were combined into a model of the camouflaging process, which we hope will contribute to the generation of testable hypotheses and identification of avenues for future research.

The themes revealed two key motivations for camouflaging: assimilation and connection. This suggests that camouflaging behaviours come from multiple sources. They may be internally driven by the individual to accomplish specific goals such as friendships, but they may also be produced as a response to external demands placed on how a person should behave in society. The differential influence of each of these motivations varies between individuals, but our findings suggest that people are strongly motivated by wanting to avoid discrimination and negative responses from others. This conclusion is supported by a recent study demonstrating that non-autistic individuals judge autistic people more negatively, and are less willing to interact with them, even after only brief exposure to the autistic individual (Sasson et al. 2017). Several participants suggested that improved education and acceptance of ASC amongst the general public would improve their social experiences significantly, and would allow them to both fit in and increase their connections without the need to camouflage.

Respondents described a wide variety of techniques used as part of their camouflaging behaviours, and further research is needed to determine the extent to which specific techniques can be generalised to all people who camouflage. The two main themes found here, masking and compensation, appear to relate to the motivations of fitting in and forming connections respectively; respondents used techniques to mask their ASC in order to appear like other people around them, and compensated for their social communication difficulties in order to make better connections with others. However, it remains to be seen whether these two goals of camouflaging are entirely separate, or whether the same techniques can be used to further both aims.

There was extensive variation in the consequences of camouflaging reported, but one of the most striking findings was that the vast majority of participants reported some unpleasant and unwanted consequences of camouflaging. These included the exhaustion experienced during and after camouflaging, which has been identified in previous research (Tierney et al. 2016). Our findings suggest that, if people with ASC want to continue camouflaging in the ways reported in our study, those supporting them

should be aware of the associated strains. Time alone to recover was identified as an important tool to help participants continue camouflaging, and could be utilised by employers and schools to make these environments more accessible for ASC individuals.

In addition, a profound consequence of camouflaging was a change in self-perceptions, as detailed by the theme 'I'm not my true self'. Camouflaging appears to challenge many participants' views towards themselves, and produce negative emotions and attitudes, such as being a 'fake' or losing their identity. It may be that the rigidity of thinking and scrupulous honesty that are present in many individuals with ASC leads them to view any change in self-presentation as false (Chevallier et al. 2012). Regular camouflaging would consequently increase the individual's perception of themselves as a 'liar' or inauthentic person, and could lead to long-term negative impacts on self-esteem. This could account for the finding that some participants viewed camouflaging as lying, in contrast to those who viewed it as a performance.

We can only speculate whether differences in participants' attitudes towards camouflaging, including the motivations and techniques used, may lead to differences in the consequences of camouflaging. Interestingly, positive consequences were reported more frequently by males than females or those of other genders. This could suggest that camouflaging is more likely to be a satisfying process for males with ASC given present gendered social-cultural contexts; alternatively, it may reflect gender differences in the actual camouflaging techniques used, which produce different consequences. However, some participants reported that their camouflaging strategies were not always performed successfully; a relatively large proportion of these participants were male, in contrast to the gender ratio of the overall sample. There may be a discrepancy between desire to camouflage and ability to do so, and this too should be investigated in different genders and across the entire autism spectrum. The potential gender difference corresponds well with a recent study showing on-average lower level of camouflaging and stronger association between camouflaging and depressive symptoms (i.e. the more camouflaging, the higher level of depression) in men with ASC, compared to women with ASC (Lai et al. 2016). It may be that females with ASC who camouflage tend to do so more successfully than males.

Previous researchers have suggested that camouflaging by females with ASC might account for the gender disparity in diagnosis (Gould and Ashton-Smith 2011; Kreiser and White 2014; Lai et al. 2015). Our study is not designed to directly test this idea, or to compare the extent of camouflaging between different groups. We found that relatively equal numbers of males and females, and all individuals of other genders, reported camouflaging, and no consistent

patterns of differences in camouflaging behaviours between males and females were identified. However, some female and other-gender participants argued that camouflaging was a specific reason for their own or others' late diagnosis, suggesting that society places higher demands on social ability and assimilation for people perceived as female. Indeed, a recent study in elementary school children shows that the gendered, female social landscape supports ASC girls for camouflaging (e.g., staying in close proximity to peers) and therefore if clinicians and teachers rely on a male landscape to detect ASC characteristics (e.g., social isolation on the playground), females will tend to be left unidentified (Dean et al. 2016). Further examination of the impact of camouflaging behaviours in all genders is essential to understand the difficulties in accessing support by those who do not show a 'typical' ASC presentation.

One explanation for the similarities in camouflaging between males and females found here is that our sample was self-selecting, in response to a call for participants for 'a study looking at experiences of coping behaviours in social situations'. Although previous experience of camouflaging was not required to take part in the study, potential participants might have interpreted the advertisement in this way. It is therefore possible that our sample comprised only those people who had experienced camouflaging, which might include a substantial number of ASC females, but a smaller proportion of ASC males. The majority of those who did not take part, because they had never or only rarely experienced camouflaging, may have more likely been male. This would account for the high proportion of female participants in our study, in contrast to previous research into ASC. Further investigation of camouflaging behaviours across the entire ASC population would shed more light on this.

An alternative explanation is that camouflaging is equally common in males and females with ASC. Previous research has either theorised that camouflaging is more common in females (Lai et al. 2011; Wing 1981), has only included female samples (Bargiela et al. 2016; Tierney et al. 2016), or has observed on-average more evident camouflaging in females than males (Dean et al. 2016; Lai et al. 2016). If camouflaging does indeed lead to not receiving the diagnosis, there may, in fact, be a significant number of both males and females with ASC missing out on the support they might need. Future research could test this possibility by comparing camouflaging levels in males and females with high ASC traits, but who have not received an ASC diagnosis. However, this also leads to a point that was raised by some of the participants who reported not camouflaging—the concept that if people are camouflaging so successfully that they are not diagnosed, they may not need a diagnosis or related support. While this may seem plausible to those who view camouflaging as a successful,



low-impact strategy, the significant difficulties and uncertainty reported by our participants tell us that people who camouflage still need to be able to access appropriate support.

This issue reflects a concern voiced by some participants, viz. that increasing the awareness of camouflaging in the general public might actually lead to worse outcomes for some individuals with ASC. Those participants who used camouflaging to hide their ASC, especially at work, often viewed their camouflaging as a defensive strategy protecting them from discrimination. They worried that if other people were able to identify camouflaging, the ASC individual might lose this protection and be treated unfairly. It remains to be seen how much camouflaging in ASC can be identified by others. Many participants felt their camouflaging was at times unsuccessful, or reported occasions where another person had commented on their techniques. This concern suggests that research and public education regarding camouflaging needs to be performed in consultation with a range of people from the ASC community to ensure that increasing information helps rather than harms. More crucially, this concern voiced by some participants once again emphasises that the outcome of individuals with ASC does not solely rely on personal characteristics—it can more fundamentally rely on how the social contexts treat them. A better person-environment fit is the key, and this involves ‘treating the environment’ to reduce stigmatization attached to autism and barriers to social life (Lai and Baron-Cohen 2015).

#### Strengths and Limitations

One strength of this study was the high proportion of females and those of non-binary gender, many of whom were diagnosed later in life. This is an under-represented population, and it is important to include their voices and insights, which may be different to those of the majority male, younger samples included in previous research. However, because of this our sample was not fully representative of the entire ASC community. Intellectual ability was not measured, although it can be assumed that participants should have had close to or average cognitive abilities in order to be able to complete the online, text-based survey. The cognitive and self-reflecting abilities required to complete the survey may also mean that our sample were better able to perform successful camouflaging behaviours than others on the autism spectrum.

As a result, our findings cannot be said to represent the views of those with ASC who also have intellectual disability, or who cannot express themselves in written English. Developing more accessible measures of camouflaging, such as self-report questionnaires that can be orally or visually administered, or measures to identify camouflaging

behaviours, would improve our ability to understand camouflaging across the whole ASC community. This study was not designed to measure camouflaging behaviours across the ASC population, but to identify the component parts of the construct of camouflaging. We hope that with these results, future research can investigate the functional and demographic characteristics of those individuals with ASC who do or do not camouflage, including those with non-binary gender identities and/or gender dysphoria, characteristics that may also contribute to the need for camouflaging, and should be explored in their own right. Larger and more varied samples of individuals from across the autism spectrum should be included to further refine our understanding of camouflaging in the future.

As previously mentioned, our sample only included adults with a confirmed diagnosis of ASC; it is therefore possible that those who are most likely to camouflage were not included in our study as they would not have met the diagnostic criteria. A typically developing comparison group was not included in this study due to the difficulty of operationalising camouflaging for individuals with limited ASC-related characteristics. However, several participants reported having camouflaged for years before receiving a diagnosis later in life, suggesting that our findings have relevance for undiagnosed ASC individuals. Using the behaviours and themes identified in this study, descriptions of camouflaging suitable for the general population can now be developed. Future research in individuals with high levels of ASC traits, regardless of their diagnosis, may reveal more about how camouflaging varies between those who do and do not receive an ASC diagnosis. In addition, further qualitative and quantitative research comparing the camouflaging experiences of individuals from different age groups may reveal more about how camouflaging develops and changes across the lifespan.

The inductive nature of this study has resulted in novel avenues for research, such as focusing on the impact of camouflaging on identity, which may not have otherwise been considered. In addition, although camouflaging has previously been described as mainly a female expression of ASC, we found that many males and individuals of other genders also reported camouflaging. A recent study operationalising camouflaging using existing ASC-related measures also shows wide variability of the level of camouflaging in both men and women with ASC, indicating that camouflaging is not a female-specific phenomenon (Lai et al. 2016). In the present study, no statistically tested gender differences in camouflaging behaviours or outcomes were presented due to the qualitative nature of the data, and no analysis of the subjective or objective success of camouflaging attempts was made. However, our findings have produced the first known conceptual model of camouflaging, with key themes and components as identified by

individuals who camouflage. We hope that future research in this area will use the themes identified here to develop precise, testable hypotheses for qualitative or quantitative research into camouflaging and the sex- and gender-informed phenotypes of ASC.

The next stage of research requires the development of measures of camouflaging behaviours, in order to standardise and compare camouflaging experiences between autistic and non-autistic individuals and allow for follow-up quantitative research. We hope that the model presented in this paper, and in particular the behaviours described in the 'masking' and 'compensation' themes, will provide a framework for the development of such a measure. Furthermore, studies delineating component psychological constructs and interpersonal-contextual processes underlying the themes identified here will deepen our understanding of the mechanisms underlying camouflaging. Eventually this may lead to novel support strategies and advocacy that maximise the positive consequences and minimise the negative consequences of camouflaging—and to attain the most appropriate person-environment fit for each individual with ASC.

## Conclusions

This study demonstrates that camouflaging of ASC-related characteristics in social situations may be a common behaviour amongst adults with ASC. Camouflaging is motivated by the desire to fit in with others and to make connections. The behaviours themselves can be grouped into masking and compensation strategies. In the short term, camouflaging results in extreme exhaustion and anxiety; although the aims of camouflaging are often achieved, in the long-term there are also severe negative consequences affecting individuals' mental health, self-perception, and access to support. Our findings demonstrate that camouflaging is an important aspect in the lives of many individuals with ASC. Future research is needed to quantitatively measure camouflaging and compare techniques in individuals with ASC of all genders, to identify demographic and ASC characteristics associated with individual variation in camouflaging and its outcomes, to uncover underlying psychological and interpersonal/contextual processes, and to devise strategies that minimise negative impacts of camouflaging and facilitate the realization of maximal individual potential.

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## Compliance with Ethical Standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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## Development and Validation of the Camouflaging Autistic Traits Questionnaire (CAT-Q)

Laura Hull<sup>1,6</sup> · William Mandy<sup>1</sup> · Meng-Chuan Lai<sup>2,3,4</sup> · Simon Baron-Cohen<sup>3</sup> · Carrie Allison<sup>3</sup> · Paula Smith<sup>3</sup> · K. V. Petrides<sup>5</sup>

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### Abstract

There currently exist no self-report measures of social camouflaging behaviours (strategies used to compensate for or mask autistic characteristics during social interactions). The Camouflaging Autistic Traits Questionnaire (CAT-Q) was developed from autistic adults' experiences of camouflaging, and was administered online to 354 autistic and 478 non-autistic adults. Exploratory factor analysis suggested three factors, comprising of 25 items in total. Good model fit was demonstrated through confirmatory factor analysis, with measurement invariance analyses demonstrating equivalent factor structures across gender and diagnostic group. Internal consistency ( $\alpha=0.94$ ) and preliminary test–retest reliability ( $r=0.77$ ) were acceptable. Convergent validity was demonstrated through comparison with measures of autistic traits, wellbeing, anxiety, and depression. The present study provides robust psychometric support for the CAT-Q.

**Keywords** Autism · Camouflaging · Masking · Compensation · Coping Strategies

Social camouflaging is defined as the use of strategies by autistic people to minimise the visibility of their autism during social situations (Lai et al. 2011). This topic has recently come to the attention of researchers, as recognised by the call for clinicians to be aware of masking or coping

behaviours when assessing autism in the newly released 11th edition of the International Classification of Diseases (Zeldovich 2017), but has been described by autistic people and clinicians for many years. It may be a widespread and important phenomenon in autism, especially in intellectually able individuals. We note here that, following preferences from a majority of the autism community (Kenny et al. 2015), we use identity-first language in this paper (e.g. 'autistic person') while recognising that some individuals prefer the use of person-first language (e.g. 'person with autism'). Social camouflaging encompasses an explicit effort to 'mask' or 'compensate' for autistic characteristics; and to use conscious or unconscious techniques which result in a less autistic behavioural presentation (Hull et al. 2017; Lai et al. 2017; Livingston and Happé 2017). Examples of camouflaging behaviours described in the current literature include forcing oneself to make eye contact during a social interaction, or pretending that one is doing so by looking at the space between someone's eyes or at the tip of their nose, or using working memory strategies to develop a list of appropriate topics for conversation. Camouflaging is driven by the desire to 'fit in' so as to appear non-autistic, and to form relationships with others, which may be harder to achieve when the person presents autistic behaviour (Hull et al. 2017).

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✉ Laura Hull  
laura.hull.14@ucl.ac.uk

<sup>1</sup> Research Department of Clinical, Educational & Health Psychology, University College London, London, UK

<sup>2</sup> Child and Youth Mental Health Collaborative, Centre for Addiction and Mental Health and The Hospital for Sick Children, Department of Psychiatry, University of Toronto, Toronto, ON, Canada

<sup>3</sup> Autism Research Centre, Department of Psychiatry, University of Cambridge, Cambridge, UK

<sup>4</sup> Department of Psychiatry, National Taiwan University Hospital and College of Medicine, Taipei, Taiwan

<sup>5</sup> London Psychometric Laboratory, University College London, London, UK

<sup>6</sup> Department of Psychology, University College London, 26 Bedford Way, London WC1H 0AP, UK



The concept of social camouflaging was first investigated through qualitative research with autistic girls and women, looking in particular at reasons why these individuals may not be diagnosed until later in life. Themes identified in this research include the concept of ‘masking’, or portraying a non-autistic persona (Bargiela et al. 2016; Tierney et al. 2016), and the idea that through copying others and controlling behavioural expression, autistic girls and women could compensate for some of the social and communication difficulties they experienced (Dean et al. 2017). This qualitative research suggested that there may be some negative consequences of camouflaging. These include links to heightened stress or mental health conditions such as depression, and reduced access to clinical support and services as a result of difficulties being hidden (Cage et al. 2017; Head et al. 2014). Autistic females’ camouflaging may even account for the later and less frequent diagnoses of females than males with the same autistic characteristics (Begeer et al. 2013; Giarelli et al. 2010; Rutherford et al. 2016). In addition, some qualitative research that has begun to look at the experiences of camouflaging amongst autistic men suggests that while both men and women may camouflage their autism, there might be gendered differences in both the techniques used and the consequences of camouflaging (Hull et al. 2017).

This qualitative research has offered new insights into under-investigated social behaviours in autism, and has raised important questions to address: Who, among the many different autistic people, camouflages their autism? Do autistic girls and women camouflage more than boys and men, and does this partly account for gender disparities in the rate and timing of diagnosis (Begeer et al. 2013; Loomes et al. 2017)? What is the relationship between camouflaging and mental health outcomes? Quantitative investigation of these questions has to date been hindered by the challenges of accurately measuring camouflaging.

### Measures of Social Camouflaging

In recent years there have been some attempts to quantify social camouflaging by autistic people. The resultant instruments reflect different ways of defining and operationalising camouflaging, leading to some overlap but also some discrepancies in how camouflaging behaviours are measured.

Livingston and Happé (2017) suggest that camouflaging is a component of compensation, the “processes contributing to improved behavioural presentation of a neurodevelopmental disorder, despite persisting core deficit(s) at cognitive and/or neurobiological levels” (p. 8), and hence should be measured at the behavioural, cognitive, and neurobiological levels. We call these approaches to measuring camouflaging ‘discrepancy methods’, as they seek to measure the gap between how autistic a person is (‘internal autistic status’)

and their overt behaviours (‘external autistic presentation’). This approach was used by Lai et al. (2017), who measured the discrepancy between self-reported autistic traits on the Autism Spectrum Quotient (AQ) as well as social cognitive abilities on the Reading the Mind in the Eyes test (RMET) (internal autistic status) and scores on the Autism Diagnostic Observation Schedule (ADOS) (external autistic presentation). The study found a greater AQ/RMET-ADOS discrepancy score for female than male participants, and that higher discrepancy scores were associated with greater depressive symptoms for men, but not for women.

A similar result was found by Ratto et al. (2017), where autistic females with higher IQ were less likely to meet diagnostic criteria on the Autism Diagnostic Interview (Revised) than males, despite being matched on ADOS scores and having higher levels of parent-report functioning difficulties than males. Other studies have demonstrated autistic females’ greater use of camouflaging strategies during communication than males, whether through gesture (Rynkiewicz et al. 2016), or filling pauses in conversation (Parish-Morris et al. 2017), despite overall comparable social skills. These methods measure camouflaging by identifying discrepancies between different measures of social ability or autistic characteristics, such that individuals (especially females) appear less autistic in some settings yet still meet autism diagnostic criteria in others.

A strength of these discrepancy approaches is their conceptual rigour, as they seek to operationalize the key feature of camouflaging; that it is a dissociation between an individual’s experience of being autistic and the behaviours they portray to the outside world. In addition, using autism assessment tools as a measure of external autism presentation demonstrates the impact camouflaging can have in a clinical setting, especially for autistic women. However, a key disadvantage is that this approach relies upon an index of how autistic a person is (i.e., their internal autistic status) independent of their behavioural presentation. Given that autism is currently conceptualised at the behavioural level because there are no reliable biomarkers for the condition (American Psychiatric Association 2013; Loth et al. 2015), this represents a significant conceptual and practical challenge. Performance on tests of cognition relevant to autism, or scores on self-reported measures of autism traits can only ever be a proxy measure of internal autistic status: we currently have no way to identify how autistic an individual is meaningfully and accurately.

In addition, the measurement of camouflaging using discrepancy approaches does not allow for unsuccessful camouflaging attempts to be assessed. Some autistic people may use a variety of strategies in an attempt to appear less autistic to others, but these may be only partially or not at all successful. This is especially important when considering the evidence for a link between self-reported camouflaging and poor

mental health (Cage et al. 2017; Hull et al. 2017). If individuals attempt to camouflage but are ultimately unsuccessful this may further increase the social, emotional, and psychological harm resulting from their camouflaging efforts.

An alternative to the discrepancy approaches described above is one based on observational recognition of camouflaging; measuring the specific behaviours and experiences which represent camouflaging. Such ‘observational/reflective methods’ circumvent the limitation of being unable to measure an individual’s internal autistic state. Camouflaging can be measured consistently and compared between individuals, and behaviours can be identified regardless of how successful they are. In other words, identification of camouflaging is not reliant on either a proxy measure of internal autistic status, or the need to display a typical social presentation.

Dean et al. (2017) used an observational/reflective approach to identify camouflaging strategies used by autistic girls when interacting with peers through behavioural observation. Behavioural techniques, such as standing near to peers who are interacting, but not actually engaging in with them, were classified as camouflaging strategies, and were observed more in autistic girls than in autistic boys or non-autistic girls, in a school setting. This led to the superficial appearance of successful social interaction, but did not actually result in friendships or sustained engagement for the autistic girls using these techniques. Dean et al. operationalisation of camouflaging is based on the idea of blending into the social environment, a strength of which is that the need to camouflage may vary depending on the situation. In addition, this definition of camouflaging emphasises that camouflaging behaviours may be learned or mimicked from non-autistic peers.

This approach to camouflaging has the advantage of allowing for variation in camouflaging behaviours and their success. Techniques learned and used in some situations may not be successful in others, and an individual’s overall camouflaging ability may partly depend on their ability to adapt to different situations. The cognitive flexibility enabling this has already been suggested as one explanation for autistic girls’ superficially higher social skills (Lehnhardt et al. 2015). However, this measure of camouflaging is based on non-autistic observers’ ideas of what camouflaging looks like. Intentions and behaviours of camouflaging which clinicians and researchers may not be aware of, but which may form an important part of autistic individuals’ camouflaging strategies, have not yet been measured.

### Self-Reported Measurement of Camouflaging

Another observational/reflective approach to the operationalisation of camouflaging addresses some of these remaining issues: asking autistic people themselves about their

camouflaging behaviours. Here, camouflaging is conceptualised based on the reported experiences of individuals who have (and have not) camouflaged their autism, and the behaviours and intentions described by these individuals are used to develop a list of camouflaging strategies to measure. Autistic individuals can then report directly on their own camouflaging behaviours, identifying strategies and intentions that might not be visible to an observer without in-depth discussion with the autistic person themselves.

This self-report method, based on an observational/reflective approach, has several strengths. First, identifying camouflaging behaviours based on strategies reported by autistic individuals reduces the potential for introducing bias via researchers’ and clinicians’ perceptions of autistic behaviours and abilities. Autistic adults have previously reported being told by clinicians that their ability to camouflage (for example, by making or appearing to make eye contact) meant they could not be autistic, despite meeting autism diagnostic criteria in other ways (Hull et al. 2017). Clinicians and researchers may only observe autistic individuals in one structured and limited situation and so may not identify certain behaviours as camouflaging strategies, whereas autistic individuals and those who know them well have a unique insight into their own behaviours across a variety of situations. Second, self-report measures of camouflaging allow for operationalisation of the attempt to camouflage—the intention put into camouflaging autistic characteristics, and the techniques used, which may not result in any observable external change for someone who does not know the person well.

Both the discrepancy and observational/reflective approaches described above offer ways to define and therefore measure camouflaging in autism. All the methods used or suggested have their own strengths and weaknesses, thus combining multiple methods in a triangulation approach allows for greater accuracy in measuring and identifying a complex phenomenon such as camouflaging (Thurmond 2001). Participant report is needed to identify intention to camouflage, behavioural observation to identify how successful that camouflaging is, and measures of cognitive traits and autistic characteristics to identify how much the person is camouflaging their underlying ‘autistic-ness’ and how they do or do not achieve this. Methods for measuring behavioural camouflaging, and cognitive and autistic-like traits, already exist or have been proposed (Dean et al. 2017; Lai et al. 2017; Livingstone and Happé 2017); however until now, no self-report measures of camouflaging behaviours have been developed.

### Camouflaging Across the Dimensions

Autism is a dimensional characteristic; traits are distributed across the entire population, but with a cut-off point at the extreme end requiring clinical identification and support

(Constantino 2011; Ruzich et al. 2015; Skuse et al. 2005). All individuals in the general population have some level of autistic traits, and those with an above average number may also camouflage these to varying extent. Camouflaging is similar to impression management, where behaviours which occur in front of others are manipulated in order to make a better impression (Leary and Kowalski 1990). Autistic individuals engage in impression management to a lesser degree than non-autistic individuals (Cage et al. 2013). The combination of underlying autistic characteristics and extent of (successful) camouflaging produces an external 'autistic' presentation, with corresponding variation in general functioning (Livingston and Happé 2017). Thus, it is important to develop measures of camouflaging that are appropriate for both autistic and non-autistic populations.

### The Present Study

A psychometrically sound self-report measure of camouflaging behaviours is needed to improve current understanding of the nature, causes and consequences of social camouflaging. Furthermore, existing methods of measuring camouflaging behaviours have not been validated in both autistic and non-autistic populations.

The aim of this study is therefore to develop, psychometrically evaluate, and validate a self-report measure of social camouflaging behaviours (henceforth referred to as the Camouflaging Autistic Traits Questionnaire; CAT-Q), appropriate for both autistic and non-autistic populations.

### Development

Preliminary items for the CAT-Q were developed from qualitative responses to a previous study, and were added to and refined by all the authors and several external experts.

### Psychometric Evaluation

Exploratory and confirmatory factor analyses were used to identify, refine, and test the underlying factor structure of the CAT-Q in two separate samples. Multi-group measurement invariance analyses were used to compare the underlying factor structure in the male and female autistic and non-autistic samples.

Internal consistency of the measure was estimated using Cronbach's alpha, and test-retest reliability was established by re-sending the CAT-Q to a subsample of 30 autistic participants approximately 3 months after they first completed the survey.

Convergent validity of the new measure was determined by comparing camouflaging scores with scores on theoretically related constructs (Cronbach and Meehl 1955).

Individuals with more autistic-like traits are likely to camouflage those traits to a greater extent, although this has not been tested empirically before. Camouflaging has also been associated with increased social anxiety and general anxiety, and decreased wellbeing, in qualitative reports (Hull et al. 2017), as well as with increased depression in quantitative research (Cage et al. 2017; Lai et al. 2017). Accordingly, convergent validity was explored by testing the correlation between camouflaging and autistic-like traits, social anxiety, general anxiety, wellbeing, and depression.

## Methods

### Participants

Validation of the CAT-Q was conducted in autistic and non-autistic samples which were recruited separately. Autistic participants were recruited via social media, through the Cambridge Autism Research Database (CARD), and through word-of-mouth. Non-autistic participants were recruited via social media and through word-of-mouth. Participants who self-reported as autistic were asked to detail the type of diagnosis, (e.g. Autism, Asperger's Syndrome, Autism Spectrum Disorder), the age they were diagnosed, and the type of healthcare professional who diagnosed them. Those who reported being self-diagnosed were automatically excluded from the study and did not complete any further questions. All participants were at or above the legal age to give informed consent on their own behalf in the UK (16 years).

Of those autistic participants who reported the age they were diagnosed, 12% were diagnosed in childhood (0–17 years) and 72% were diagnosed in adulthood (18 years and over). Of those diagnosed in childhood, 38% were diagnosed by a psychiatrist, 25% by a clinical psychologist, 8% by other specialists including neurologists and specialist nurses, 5% by a multi-disciplinary team, 2% by a Speech & Language Therapist, 2% by their school, and 2% by a paediatrician. Of those diagnosed in adulthood, 55% were diagnosed by a clinical psychologist, 35% by a psychiatrist, 3% by a multi-disciplinary team, 3% by other specialists, 0.7% by a Speech and Language Therapist, 0.7% by a GP, and 0.3% by an occupational therapist.

In the autistic sample, 14% were aged 16–25, 23% were aged 26–35, 20% were aged 36–45, 13% were aged 56–65, 3% were aged 66–75, and 0.3% were aged 75 or over. In the non-autistic sample, 59% were aged 16–25, 16% were aged 26–35, 8% were aged 36–45, 9% were aged 46–55, 6% were aged 56–65, 1% were aged 66–75, and 0.2% were aged 75 or over (proportions may not add up to 1 due to rounding).



## Measures

### Camouflaging Autistic Traits Questionnaire (CAT-Q)

The measure's operationalisation of social camouflaging is based on the analysis and theoretical model described in the qualitative study by Hull et al. (2017). Items for the CAT-Q were identified through multiple routes. A previous study which asked for autistic adults' experiences of camouflaging (Hull et al. 2017) also asked participants to describe specific behaviours they used while camouflaging. These responses were refined to produce a list of behaviours reflecting the two core components of camouflaging identified previously: compensation (i.e. finding ways around the social and communication difficulties associated with autism), and masking (i.e. hiding aspects of one's autistic presentation, or presenting a non-autistic persona to others). Additional camouflaging behaviours were suggested by autism experts, including researchers, clinicians, and autistic adults who were consulted directly.

Once the behaviours were identified, items that described them, including reverse-coded items describing the opposite of these behaviours, were developed. Items were removed or added to ensure there was a roughly even number tapping into 'compensation' and 'masking'. A total of 48 items were produced for inclusion in the study. Participants responded using a seven-point Likert scale, from 'Strongly Disagree' to 'Strongly Agree' with each statement. A total of 832 participants (354 adults with autism and 478 adults without autism) completed the CAT-Q.

### Broad Autism Phenotype Questionnaire (BAPQ; Hurley et al. 2007)

A 36-item self-report measure of traits associated with the broader autism phenotype (BAP). BAP characteristics are associated with greater genetic liability for autism, and are found across the population and at especially high levels in relatives of those with an autism diagnosis. Scores for the total questionnaire and three sub-factors (Aloofness, Pragmatic Language, and Rigidity) are averaged across the 36 items in the total questionnaire and 12 in each factor, to produce values in a range of 0–6. A total of 744 participants (299 autistic and 445 non-autistic) completed the BAPQ. The BAPQ has good sensitivity (Sasson et al. 2013) and specificity (Hurley et al. 2007). Internal consistency of the BAPQ in the current study (total sample) was high ( $\alpha=0.96$ ). Although the BAPQ was initially developed as a measure of autistic-like traits in relatives of those with autism, it has also been used to measure autistic-like traits in autistic and non-autistic groups (Ingersoll et al. 2011; Nishiyama et al. 2014; although see Piven and Sasson 2014 for an evaluation of this approach). In this case we included the

BAPQ as a measure of autism-related characteristics, rather than as a screening tool for autism. Mean BAPQ scores were compared for autistic and non-autistic samples and were found to be significantly different ( $t[743]=21.23$ ,  $p<.001$ ,  $d=1.56$ ), with means of 4.31 ( $SD=0.69$ ) for autistic participants and 3.18 ( $SD=0.73$ ) for non-autistic participants. This suggests that, although the BAPQ was designed for relatives of those with autism, there were no ceiling effects in the autistic sample.

### Social Anxiety Scale (LSAS; Liebowitz 1987)

A 24-item self-report questionnaire measuring social anxiety in the general population. The scale requires participants to imagine being in different social situations (such as talking to a sales assistant in a shop) and asks how much fear they would experience and how much they would avoid the situation. The LSAS has demonstrated good test-retest reliability and discriminant validity (Baker et al. 2002). A total of 708 participants (284 adults with autism and 424 adults without autism) completed the LSAS. In the total sample of this study, internal consistency was high ( $\alpha=0.97$ ).

### Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS; Tennant et al. 2007)

A 14-item self-report questionnaire measuring general well-being in the last 2 weeks. The WEMWBS has demonstrated acceptable validity and reliability (Trousselard et al. 2016). A total of 713 participants (289 adults with autism and 424 adults without autism) completed the WEMWBS. Internal consistency in the total sample was high ( $\alpha=0.92$ ).

### Patient Health Questionnaire (PHQ-9; Kroenke et al. 2001)

A 9-item self-report questionnaire of depressive symptoms in the last 2 weeks, with a clinical cut-off point of 10 for moderate depression. The PHQ-9 has demonstrated good sensitivity and specificity for depressive symptoms (Kroenke et al. 2001). The PHQ-9 was only administered to autistic individuals. A total of 290 autistic participants completed the PHQ-9. Internal consistency in the autistic sample was acceptable ( $\alpha=0.89$ ).

### Generalised Anxiety Disorder (GAD-7; Spitzer et al. 2006)

A 7-item self-report measure of generalised anxiety symptoms in the last 2 weeks. The GAD-7 has a clinical cut-off point of 10 points and demonstrates good sensitivity and specificity (Spitzer et al. 2006). The GAD-7 was only administered to autistic individuals. A total of 289 autistic participants completed the GAD-7. Internal consistency in the autistic sample was high ( $\alpha=0.92$ ).

## Procedure

Participants followed a link to the online survey, hosted by Qualtrics, where they read the information sheet and, after contacting the researchers to answer any questions, completed a consent form. They then completed demographic questions and questionnaires.

Participants who had given contact details to researchers were contacted again 3 months later to ask them to re-take the questionnaire for the purpose of estimating test–retest reliability. At that time, adverts were also placed on social media inviting autistic participants who had previously completed the survey to complete it again.

## Analyses

All analyses were performed in R (R Core Team 2013).

The total sample was split in two, with the first half utilised for exploratory factor analysis to identify an initial factor structure from which a 25-item final scale was produced ('exploratory sample';  $N=402$ ), and the remainder utilised for confirmatory factor analysis ('confirmatory sample';  $N=430$ ). These two samples had comparable levels of autistic-like traits; however the confirmatory sample was significantly younger on average (partial  $\eta^2=0.13$ ), and contained proportionally more males (Cramer's  $V=0.12$ ), than the exploratory sample.

### Exploratory Factor Analysis

Principle components analyses using oblique rotation were performed on the total exploratory sample ( $N=402$ ), and separately in the autistic ( $N=200$ ) and non-autistic ( $N=202$ ) subsamples. Retention of items was based on combined evaluation of the scree plot, following Cattell (1966); eigenvalues over 1.0; and parallel analysis techniques to model factor structure (Hayton et al. 2004). Items with loadings below 0.40, or with cross-loadings of greater than 0.40 were excluded.

### Confirmatory Factor Analysis

Diagonally Weighted Least Square Means (WLSM) estimators were used to take into account the ordinal nature of the Likert-based responses (DiStefano and Morgan 2014; Wang and Cunningham 2005). The key indices used to assess goodness-of-fit were Comparative Fit Index (CFI), where values of 0.95 or greater indicate good fit; Root Mean Square Error of Approximation (RMSEA), where values of 0.06 or lower indicate acceptable fit; and Standardised Root Mean Square Residual (SRMR), where

values of 0.08 or lower indicate acceptable fit (Hu and Bentler 1999).

### Multi-group Measurement Invariance

The total sample was recombined and multi-group measurement invariance analysis used to determine whether the same latent variables were measured across four groups: male autistic, female autistic, male non-autistic, and female non-autistic. Participants who identified as a non-binary gender or did not report their gender were excluded from this analysis ( $n=92$ ).

Tests of measurement invariance involve the comparison of multiple, nested models (Sass 2011) measuring: (1) Configural Invariance (whether factor structure is equal across groups); (2) Metric Invariance (whether item loading on each factor is equal across groups); (3) Scalar Invariance (item intercepts are equal across groups); and (4) Residual Invariance (item residuals are equal across groups). Each model is compared to the previous in a forward approach to first establish invariance across groups, and then test whether non-invariance has been identified at each additional level.  $\Delta$ CFI of less than 0.01 is generally used as the most reliable marker of invariance, as  $X^2$  values can be influenced by sample size (Cheung and Rensvold 2002). Diagonally Weighted Least Square Means (WLSM) estimators were again used, and robust statistics are reported for all results. Satorra-Bentler scaled corrections for multiple comparisons were used.

### Reliability and Validity

Internal consistency, test–retest reliability, and convergent validity of the final scale were assessed in a subset of the total sample who had also provided complete responses to at least one of the other measures in the study ( $N=706$ ; Autistic  $N=306$ , Non-Autistic  $N=400$ ). Internal consistency was measured using Cronbach's alpha, and test–retest reliability using Pearson's  $r$  and intra-class coefficients (ICCs). Two-way consistency ICC was used to evaluate absolute consistency between the first and second completion of the questionnaire, (McGraw and Wong 1996), with unity reflecting complete consistency on all items between time one and time two. Values of 0.50 to 0.75 indicate moderate reliability, while values of 0.75 and above indicate good reliability (Koo and Li 2016).

Convergent validity was assessed using correlations between total CAT-Q and factor scores, and measures of autistic-like traits, social anxiety, well-being, generalised anxiety, and depression.

**Results**

The characteristics of the total sample and all subsamples are described in Table 1.

**Exploratory Analyses**

Parallel analysis suggested four factors, but examination of the scree plot and eigenvalues suggested that three common factors best fit the data across the autistic, non-autistic, and combined samples, in addition to being a simpler structure. The three factors were labelled Compensation (strategies used to actively compensate for difficulties in social situations), Masking (strategies used to hide autistic characteristics or portray a non-autistic persona), and Assimilation (strategies that reflect trying fit in with others in social situations). These three factors accounted for 38% of variance in the autistic subsample, 41% of variance in the non-autistic subsample, and 45% of variance in the combined exploratory sample. Factor correlations were medium-to-high (Cohen 1988) between all factors in all samples (Table 2).

Items that loaded onto one of the three factors at or above the critical value of 0.40 in both the autistic and non-autistic subsamples, and in the combined sample, were identified.

These were reduced to twenty-five items based on the highest factor loadings, which resulted in a total of 8 items each in the Masking and Assimilation factors, and 9 items in the Compensation factor. Table 3 presents the mean scores and internal consistencies of the factors and total scale across the autistic, non-autistic, and combined samples. Autistic participants scored significantly higher than non-autistic participants on the Total CAT-Q ( $t [401]=12.98, p < .001$ ; partial  $\eta^2=0.30$ ) and Compensation ( $t [401]=11.90, p < .001$ ; partial  $\eta^2=0.26$ ), Masking ( $t [401]=2.19, p = .03$ ; partial  $\eta^2=0.01$ ), and Assimilation factors ( $t [401]=16.35, p < .001$ ; partial  $\eta^2=0.40$ ). Factor loadings on all three factors in the final, 25-item Camouflaging Autistic Traits Questionnaire (CAT-Q) are detailed in Table 4.

**Confirmatory Analyses**

Confirmatory factor analysis was performed on the confirmatory sample (N = 419; Autistic N = 150, Non-Autistic N = 269); the results for the autistic, non-autistic, and combined group analyses for the total scale are reported in Table 5.

Overall the model fit was acceptable; CFI values were above 0.95, and RMSEA and SRMR values were well within

**Table 1** Sample characteristics

	Total sample	Autistic subsample	Non-autistic subsample	Exploratory subsample	Confirmatory subsample
N	832	354	478	402	430
(male/female/other gender/ not stated)	(300/434/46/52)	(108/179/17/50)	(192/255/29/2)	(139/246/17/0)	(161/188/29/52)
Mean age in years (SD)	36.01 (14.84)	41.93 (13.55)	30.24 (13.72)	37.02 (15.02)	35.15 (14.21)
Age range in years	16–82	18–75	16–82	16–82	16–72
Mean age at autism diagnosis (range)	–	34.2 (2–66)	–	34.47 <sup>a</sup> (2–66)	33.82 <sup>a</sup> (3–66)
Native language = English	617	244	373	346	271
Employed full- or part-time	308	135	173	182	126
Student	257	36	221	123	134
Retired or homemaker	62	43	19	39	23
Unemployed or unable to work	86	64	22	42	44

NB: some participants chose not to answer some demographic questions

<sup>a</sup>Value for autistic participants only

**Table 2** Factor correlations in autistic, non-autistic and combined (Com) samples

	Compensation			Masking			Assimilation		
	Autistic	Non-Autistic	Com	Autistic	Non-autistic	Com	Autistic	Non-autistic	Com
Compensation	–	–	–	0.5	0.47	0.39	0.44	0.58	0.66
Masking	0.5	0.47	0.39	–	–	–	0.21	0.39	0.33
Assimilation	0.44	0.58	0.66	0.21	0.39	0.33	–	–	–

**Table 3** CAT-Q total and factor scores in the autistic (N=200) and non-autistic (N=202) subsamples and the combined exploratory sample (Com; N=402)

Scale	No. of items	Mean (SD)			Internal consistency (Cronbach's $\alpha$ )		
		Autistic	Non-autistic	Com	Autistic	Non-autistic	Com
Total	25	4.79 (0.99)	3.48 (1.04)	4.13 (1.21)	0.91	0.93	0.94
Compensation	9	4.42 (1.31)	2.89 (1.27)	3.65 (1.50)	0.88	0.90	0.92
Masking	8	4.55 (1.35)	4.29 (1.10)	4.42 (1.24)	0.87	0.84	0.86
Assimilation	8	5.29 (1.15)	3.32 (1.27)	4.30 (1.56)	0.86	0.89	0.93

Raw Scores have been rescaled to reflect the 7-Point Likert Scale

the recommended range in all three samples. The model tested is detailed in Fig. 1.

### Invariance Analyses

Measurement invariance (as demonstrated by  $\Delta CFI < 0.01$ ) was found for item loadings (Model 2), intercepts (Model 3), and residuals (Model 4) between the autistic and non-autistic male and female samples (as shown in Table 6). Model fit was close to or within acceptable limits for all models. It was concluded that the CAT-Q demonstrates strict invariance between autistic and non-autistic males and females.

### Reliability and Validity

Reliability and validity of the finalised, 25-item scale were assessed in a subset of the total sample that had also provided complete responses to at least one of the other measures included (N=706; Autistic N=306, Non-Autistic N=400).

### Reliability

High internal consistency was found for the total scale (Cronbach's  $\alpha = 0.94$ ), and the Compensation ( $\alpha = 0.91$ ), Masking ( $\alpha = 0.85$ ), and Assimilation ( $\alpha = 0.92$ ) factors. Correlations between each factor and the total score were calculated using item-total correlation, and the corrected factor-total correlations in the total sample were: Compensation  $\alpha = 0.705$ ; Masking  $\alpha = 0.483$ , Assimilation  $\alpha = 0.627$ .

Test-retest reliability was calculated in a subsample of 30 autistic participants, who completed the CAT-Q again online three months after initial testing. This subsample was significantly older on average than the total autistic sample ( $F[1, 331] = 12.61, p < .001$ ; mean difference = 9.23 years [ $SE = 2.6$ ]). However, there was no significant difference in the distribution of genders (Male, Female, Other Gender, and not stated) ( $X^2 [4] = 1.66, p = .80$ ), and no significant difference in mean Total BAPQ score ( $t[299] = 0.55, p = .59$ ) between this subsample and the total autistic sample. Good stability was found, as measured by Pearson's  $r$  and intra-class correlations (ICC) for the total scale and the

Compensation factor, while moderate stability was found for the Masking and Assimilation factors (Table 7). No significant difference between scores at Time 1 and Time 2 was found ( $F[1, 29] = 0.23, p = .63$ ).

### Validation

Correlations were performed between the total and factor CAT-Q scores, and scores on autistic-like traits (total BAPQ score and subscale scores), social anxiety (total LSAS score), wellbeing (total WEMWBS score), generalised anxiety (total GAD-7 score), and depression (total PHQ-9 score) in order to investigate convergent validity. Results in the autistic and non-autistic samples are detailed in Table 8. Generalised anxiety and depression scores were available for autistic participants only.

The total CAT-Q score and all CAT-Q factors were significantly positively correlated with autistic-like traits and social anxiety in autistic and non-autistic samples, with the exception of the Masking factor, which was not significantly related to autistic-like traits in the autistic sample. The total CAT-Q and all CAT-Q factors were significantly negatively correlated with wellbeing in the non-autistic sample; however, in the autistic sample, only total CAT-Q and the Assimilation factor were significantly negatively correlated with wellbeing. Depression and generalised anxiety were only measured in the autistic sample; both of these were significantly positively correlated with total CAT-Q and all its factors.

### Discussion

This study psychometrically tested the newly developed Camouflaging Autistic Traits Questionnaire (CAT-Q) in autistic and non-autistic samples. Exploratory factor analysis identified a three-factor structure, consisting of Compensation (strategies used to compensate for social and communication difficulties), Masking (strategies used to present a non-autistic or less autistic persona to others), and Assimilation (strategies used to fit in to uncomfortable social situations). The structure of the refined, 25-item CAT-Q (see



**Table 4** Factors loadings of the 25-Item CAT-Q in autistic, non-autistic and combined (Com) exploratory subsamples

Item	Factors								
	Compensation			Masking			Assimilation		
	Autistic	Non-autistic	Com	Autistic	Non-autistic	Com	Autistic	Non-autistic	Com
When I am interacting with someone, I deliberately copy their body language or facial expressions	<b>0.48</b>	<b>0.60</b>	<b>0.58</b>	0.17	0.08	0.15	0.00	0.06	0.01
I learn how people use their bodies and faces to interact by watching television or films, or by reading fiction	<b>0.73</b>	<b>0.76</b>	<b>0.77</b>	0.09	0.04	0.06	-0.10	0.01	0.02
I have tried to improve my understanding of social skills by watching other people	<b>0.73</b>	<b>0.73</b>	<b>0.73</b>	0.04	0.03	0.04	-0.13	0.02	0.04
I will repeat phrases that I have heard others say in the exact same way that I first heard them	<b>0.59</b>	<b>0.53</b>	<b>0.57</b>	-0.28	0.15	-0.06	0.22	0.09	0.18
I practice my facial expressions and body language to make sure they look natural	<b>0.51</b>	<b>0.61</b>	<b>0.61</b>	<b>0.32</b>	0.15	0.25	-0.03	0.04	-0.03
I have spent time learning social skills from television shows and films, and try to use these in my interactions	<b>0.83</b>	<b>0.72</b>	<b>0.79</b>	-0.01	-0.01	0.01	-0.03	0.15	0.09
In my own social interactions, I use behaviours that I have learned from watching other people interacting	<b>0.76</b>	<b>0.74</b>	<b>0.73</b>	0.02	0.13	0.10	-0.03	0.01	0.04
I have researched the rules of social interactions (for example, by studying psychology or reading books on human behaviour) to improve my own social skills	<b>0.61</b>	<b>0.41</b>	<b>0.56</b>	0.06	0.02	0.03	-0.01	0.15	0.14
I have developed a script to follow in social situations (for example, a list of questions or topics of conversation)	<b>0.53</b>	<b>0.46</b>	<b>0.48</b>	0.02	0.17	0.09	0.28	0.16	0.28
I monitor my body language or facial expressions so that I appear relaxed	0.03	<b>0.32</b>	0.17	<b>0.85</b>	<b>0.60</b>	<b>0.75</b>	0.02	0.04	-0.02
I adjust my body language or facial expressions so that I appear relaxed	0.08	<b>0.31</b>	0.22	<b>0.79</b>	<b>0.56</b>	<b>0.69</b>	-0.06	0.06	-0.04
I monitor my body language or facial expressions so that I appear interested by the person I am interacting with	0.11	0.22	0.16	<b>0.71</b>	<b>0.52</b>	<b>0.66</b>	0.12	0.09	0.03
I adjust my body language or facial expressions so that I appear interested by the person I am interacting with	0.06	0.23	0.15	<b>0.74</b>	<b>0.57</b>	<b>0.69</b>	0.07	0.08	0.02
I don't feel the need to make eye contact with other people if I don't want to (Reversed)	-0.02	-0.23	-0.18	<b>0.59</b>	<b>0.30</b>	<b>0.52</b>	-0.01	0.14	0.01
In social interactions, I do not pay attention to what my face or body are doing (Reversed)	0.00	0.07	0.03	<b>0.82</b>	<b>0.47</b>	<b>0.69</b>	-0.11	0.12	-0.01
I always think about the impression I make on other people	-0.01	0.02	-0.08	<b>0.39</b>	<b>0.61</b>	<b>0.52</b>	0.17	0.05	0.13
I am always aware of the impression I make on other people	-0.10	-0.06	-0.16	<b>0.44</b>	<b>0.63</b>	<b>0.54</b>	0.01	-0.16	-0.08
I rarely feel the need to put on an act in order to get through a social situation (Reversed)	0.00	-0.13	-0.08	0.24	0.19	0.21	<b>0.56</b>	<b>0.69</b>	<b>0.71</b>
When talking to other people, I feel like the conversation flows naturally (Reversed)	-0.08	-0.11	-0.03	-0.14	-0.02	-0.13	<b>0.70</b>	<b>0.75</b>	<b>0.85</b>
When in social situations, I try to find ways to avoid interacting with others	0.01	0.28	0.14	-0.21	-0.21	-0.18	<b>0.66</b>	<b>0.66</b>	<b>0.75</b>
In social situations, I feel like I'm "performing" rather than being myself	0.04	0.04	0.06	0.12	0.27	0.11	<b>0.70</b>	<b>0.57</b>	<b>0.75</b>
I have to force myself to interact with people when I am in social situations	0.06	0.17	0.10	-0.05	-0.11	-0.05	<b>0.72</b>	<b>0.72</b>	<b>0.77</b>



**Table 4** (continued)

Item	Factors								
	Compensation			Masking			Assimilation		
	Autistic	Non-autistic	Com	Autistic	Non-autistic	Com	Autistic	Non-autistic	Com
In social situations, I feel like I am pretending to be “normal”	0.00	0.21	0.09	0.19	0.18	0.13	<b>0.65</b>	<b>0.58</b>	<b>0.74</b>
I need the support of other people in order to socialise	0.08	<b>0.31</b>	0.16	−0.11	−0.04	−0.07	<b>0.60</b>	<b>0.52</b>	<b>0.66</b>
I feel free to be myself when I am with other people (Reversed)	−0.07	−0.15	−0.10	0.19	0.10	0.09	<b>0.63</b>	<b>0.69</b>	<b>0.81</b>

Loadings of 0.30 and greater are in bold

Online Appendix 1) was corroborated through confirmatory factor analysis, and measurement invariance was established between all four groups, suggesting that the CAT-Q is appropriate for use in clinical and non-clinical populations, and that scores can be compared between males and females. The CAT-Q demonstrated acceptable to good internal consistency and reliability over a period of 3 months. However, as the test–retest reliability analyses were conducted only in the older autistic sample, we report these findings as preliminary and suggest future research replicates these analyses in more diverse autistic and non-autistic samples.

The factors of Compensation and Masking reflect the two components of camouflaging proposed in a previous conceptual model derived from qualitative research (Hull et al. 2017). The third factor (‘Assimilation’) represents attempts to blend in to social situations in which the individual is uncomfortable, without letting others see this discomfort. These motivations for camouflaging have been described in previous research, although not extensively (Hull et al. 2017; Tint and Weiss 2017). The strategies within the Assimilation factor included avoiding social situations or managing them with the help of others, alongside items reflecting the feeling of not being one’s self during interactions. The factor reflects comments made by autistic adults that they often choose to camouflage

in situations where they do not know others well, whereas they feel free to be themselves while alone or with trusted others (Hull et al. 2017).

The model tested here provided a good fit in both autistic and non-autistic samples. Total CAT-Q score was positively correlated with autistic-like traits in both samples, suggesting that the higher level of autistic-like traits a person has, the more they will camouflage those traits, regardless of autism diagnosis. As high-level, successful camouflaging may result in missed clinical diagnoses (Tierney et al. 2016), the CAT-Q could be used to identify camouflaging behaviours in individuals considered at-risk for autism, but who do not currently meet diagnostic criteria. Measurement invariance analyses also demonstrated that the underlying structure of the CAT-Q is comparable in male and female autistic and non-autistic samples; in other words, the CAT-Q measures the same latent constructs in both genders and diagnostic groups. However, autistic participants scored significantly higher than non-autistic participants on the total CAT-Q and all three factors in the exploratory sample, demonstrating that the CAT-Q measures behaviours that are more common in individuals who have been diagnosed with autism spectrum conditions.

The Masking factor demonstrated the smallest difference between autistic and non-autistic samples in this analysis, suggesting that there may be more overlap between these two groups than for the other factors. Masking may be less specific to autism than the other components of camouflaging, and may reflect more general self-presentation or impression-management strategies applied to autistic characteristics. However, further research is needed to directly compare masking strategies and other self-presentation strategies in autistic and non-autistic samples to determine similarities and differences. In the autistic sample, masking was not significantly correlated with autistic-like traits, suggesting that it may be a response to the identification of being autistic rather than to the presence of specific autistic characteristics; in contrast, a significant positive relationship between the two was observed for the non-autistic sample,

**Table 5** Fit of 25-Item Full CAT-Q Scale across autistic (N=154), non-autistic (N=276) and Combined confirmatory samples (Com; N=430)

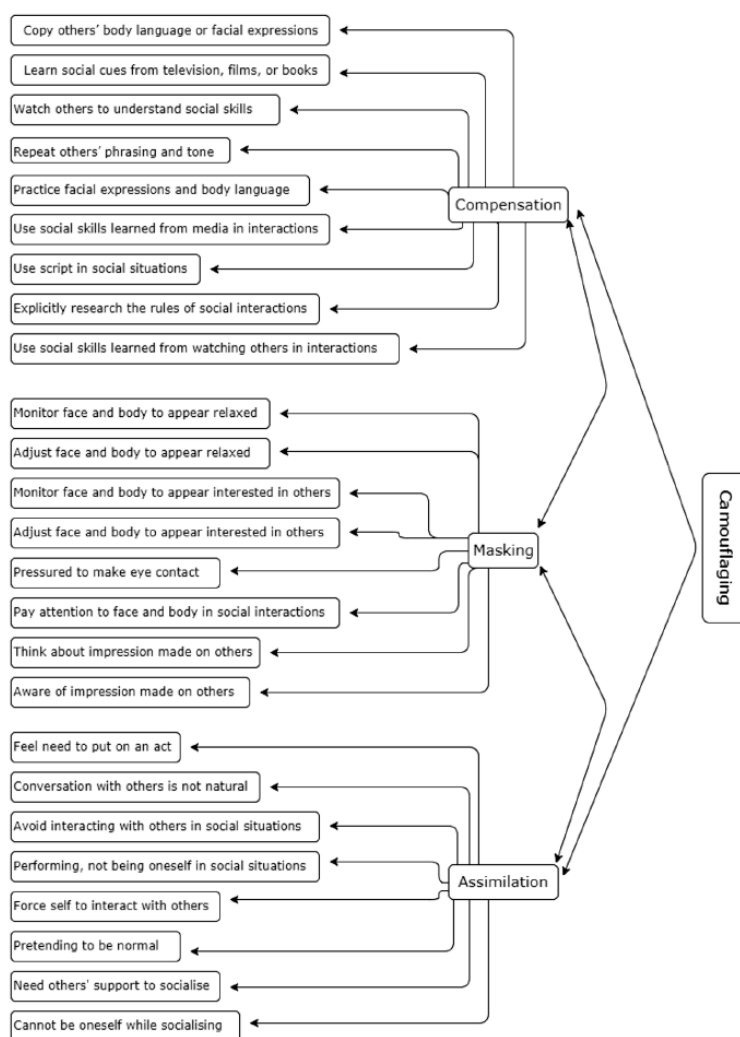
Sample	X <sup>2</sup>	Df	CFI	RMSEA (90% CI)	SRMR
Autistic	596.947*	272	0.970	0.056 (0.050–0.063)	0.075
Non-Autistic	619.099*	272	0.983	0.046 (0.041–0.051)	0.058
Com	969.527*	272	0.980	0.052 (0.048–0.055)	0.057

Robust Statistics are reported

CFI Comparative Fit Index, RMSEA root mean square error of approximation, 90% CI 90% confidence intervals, SRMR standardised root mean square residual

\*p < .0001. X<sup>2</sup>= Chi squared; Df= degrees of freedom

**Fig. 1** Social Camouflaging model



**Table 6** Multi-group measurement invariance model comparison (autistic male N=107; autistic female N=181; non-autistic male N=192; non-autistic female N=256)

Model	X <sup>2</sup>	ΔX <sup>2</sup>	Df	CFI	ΔCFI
1. Configural invariance	2434.22	–	1088	0.947	–
2. Metric invariance	2353.93	80.29	1154	0.953	0.006
3. Scalar invariance	2628.31	272.38	1220	0.945	0.008
4. Residual invariance	2856.15	227.84	1295	0.939	0.006

Robust statistics are reported

X<sup>2</sup> chi squared, ΔX<sup>2</sup> chi square difference, Df degrees of freedom, CFI Comparative Fit Index, ΔCFI CFI difference

**Table 7** Test–retest reliability of Camouflaging Autistic Traits Questionnaire and factors in autistic subsample (N=30)

	Pearson's r	ICC[C,1]	95% CI
Total CAT-Q	0.77	0.77	0.73, 0.79
Compensation factor	0.78	0.77	0.72, 0.82
Masking factor	0.70	0.70	0.63, 0.76
Assimilation factor	0.73	0.73	0.67, 0.78

**Table 8** Correlations between CAT-Q Total and factor scores and autistic traits (BAPQ), social anxiety (LSAS), wellbeing (WEMWBS), depression (PHQ), and generalised anxiety (GAD) for the autistic (N = 306) and non-autistic (N = 400) subsamples

	Total BAPQ	BAPQ: Aloof	BAPQ: pragmatic language	BAPQ: rigidity	Total LSAS	WEMWBS	PHQ	GAD
Autistic								
CAT-Q total	0.34***	0.24***	0.33***	0.28***	0.44***	−0.16*	0.28***	0.35***
Compensation	0.21***	0.08	0.27***	0.18**	0.30***	−0.02	0.18**	0.25***
Masking	−0.03	−0.07	−0.03	0.01	0.19**	−0.02	0.16**	0.20***
Assimilation	0.72***	0.63***	0.62***	0.54***	0.60***	−0.37***	0.35***	0.41***
Non-autistic								
CAT-Q total	0.67***	0.58***	0.56***	0.54***	0.60***	−0.43***	−	−
Compensation	0.54***	0.42***	0.52***	0.44***	0.46***	−0.31***	−	−
Masking	0.32***	0.24***	0.24***	0.32***	0.35***	−0.24***	−	−
Assimilation	0.78***	0.77***	0.62***	0.59***	0.69***	−0.53***	−	−

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ 

suggesting that the two groups may have been using masking strategies in response to different motivations.

Previous research suggested that camouflaging in autistic adults may be associated with poor mental health outcomes, especially anxiety, depression, and generally poor quality of life (Cage et al. 2017; Hull et al. 2017; Lai et al. 2017). The positive correlations between the CAT-Q and measures of social anxiety, anxiety, and depression, and the negative correlation between the CAT-Q and wellbeing, support this idea and offer convergent validation of the measure. Greater total camouflaging appears to be associated with poorer mental health outcomes overall, although interestingly the Compensation and Masking factors were not significantly associated with wellbeing in the autistic sample. This may reflect individual differences in the impact or success of camouflaging; previous research found that associations between camouflaging and negative outcomes were stronger for autistic men than women (Lai et al. 2017). Further assessment of gender differences and other individual differences in camouflaging behaviours and their association with wellbeing and mental health in this sample is currently underway.

### Strengths and Limitations

A significant strength of this approach is that the items were developed based on information from autistic people themselves, describing their own experiences of camouflaging. This ensures that behaviours which may not have been previously identified as part of social camouflaging by non-autistic clinicians and researchers can be measured. The CAT-Q can be used in combination with observed behavioural and cognitive measures of camouflaging to assess all aspects of this complex phenomenon. It may also have clinical implications to identify levels of camouflaging along with other clinical information, including those derived from current

autism diagnostic measures, to enhance the sensitivity and specificity of clinical diagnosis, formulation, and support planning; however, the clinical utility requires further clinical research to establish.

In addition, the CAT-Q does not require an official diagnosis of an autism spectrum condition for camouflaging behaviours to be assessed, as the underlying structure shows invariance between autistic and non-autistic populations. This addresses some issues in current autism research, especially that criteria for autistic participants may be based on an overly restricted and potentially inaccurate operational definition of autism. Even if autism diagnostic criteria change in the future, use of the CAT-Q should not vary between clinical and non-clinical groups. The CAT-Q has demonstrated measurement invariance between male and female participants, enabling comparison across genders in future research.

This study is not without its limitations. First, although the BAPQ has demonstrated validity and reliability in clinical and non-clinical samples (Ingersoll et al. 2011; Nishiyama et al. 2014), it was developed for use with relatives of those with an autism diagnosis. Therefore we are cautious about using BAPQ scores as a measure of autistic traits in clinical and general population samples (Piven and Sasson 2014). In future, to accurately examine how camouflaging is related to autistic traits, the CAT-Q should be compared to a measure of autistic traits which has been explicitly developed for use in autistic populations, for example, the severity score of the ADOS-2.

Second, no behavioural measure of social ability was included in the study. Individuals with greater social skills are less likely to need to camouflage in the first place, and may do so more effectively than those with poorer social skills. Further research is needed to identify the extent to which social skills predict camouflaging behaviours, which

will have implications regarding prevailing social skills training in autistic individuals. There was also no objective validation of self-reported autism diagnosis. However, only participants who reported receiving a diagnosis from a healthcare professional were included in the autistic sample. Third, responses on the PHQ-9 and GAD-7 were not available for non-autistic participants as these data were collected as part of a separate project; the relationship between camouflaging and depression and anxiety should therefore also be examined in non-autistic adults.

Fourthly, the self-report CAT-Q only measures individuals' own reflections/perceptions of their camouflaging behaviours, and is thus limited in its use to those who are able to reflect on their own behaviours and provide insight to their motivations. The CAT-Q may therefore not be useful for autistic individuals with language difficulties or intellectual disability. By combining this measure with behavioural or informant-report measures of camouflaging, estimates of camouflaging behaviours in those who have less insight or ability to communicate it can also be obtained.

Fifthly, the CAT-Q was created mainly based on reflections from autistic adults, and was psychometrically examined and validated in the present adult sample, in which a substantial proportion of the autistic participants received their diagnoses in adulthood instead of childhood. Hence, although the validity and potential clinical utility are likely ensured in autistic adults, in particular those who are diagnosed in adulthood (Lai and Baron-Cohen 2015), it is still unclear whether the psychometric properties and potential utilities hold for adolescents and older children, with or without autism, or for those with intellectual disability. Further testing of the CAT-Q in samples of varying ages and abilities, including adults who were diagnosed in childhood, should be conducted to measure its factor structure, validity and reliability across these groups. As the confirmatory sample contained more males than females, these analyses should also be replicated in a gender-matched sample. Finally, although the validation of the CAT-Q supports previous research suggesting camouflaging is associated with poorer wellbeing and mental health outcomes, only correlational relationships were identified. Longitudinal or intervention researches are necessary to confirm the causal nature of these relationships, and to establish the mechanisms and individual characteristics that may predict outcomes of camouflaging.

## Conclusions

The CAT-Q is a valid and reliable self-report measure of adults' social camouflaging behaviours, suitable for use in autistic and non-autistic male and female populations. It can be used in research settings to quantify camouflaging

behaviours and compare between groups; in clinical settings as a potential screening tool for individuals who may be missed under current autism diagnostic criteria because they camouflage; and by autistic and non-autistic people to aid identification of beneficial or harmful behaviours they use in social situations. Further validation of the CAT-Q in more diverse samples is encouraged in the future, alongside comparison with existing measures of camouflaging and broader social skills.

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**Author Contributions** LH conceived of the study, participated in the design and coordination of the study, performed analyses, and drafted the manuscript. WM, MCL, and SBC conceived of the study, participated in its design, coordination, and analyses, and revised the manuscript. CA and PS conceived of the study, and participated in its coordination. KVP participated in the design and analyses, and revised the manuscript. All authors read and approved the final manuscript.

## Compliance with Ethical Standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

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**Gender Differences in Self-Reported Camouflaging in Autistic and Non-Autistic Adults**

Journal:	<i>Autism</i>
Manuscript ID:	AUT-19-0085.R2
Manuscript Type:	Original Article
Keywords:	Camouflaging, Autism, Masking, Compensation, Gender Differences, Females, Adult
Abstract:	<p>Social camouflaging describes the use of strategies to compensate for and mask autistic characteristics during social interactions. A newly-developed self-reported measure of camouflaging (the Camouflaging of Autistic Traits Questionnaire; CAT-Q) was used in an online survey to measure gender differences in autistic (n = 306) and non-autistic adults (n = 472) without intellectual disability for the first time. Controlling for age and autistic-like traits, an interaction between gender and diagnostic status was found: autistic females demonstrated higher total camouflaging scores than autistic males (partial <math>\eta^2 = .08</math>), but there was no camouflaging gender difference for non-autistic people. Autistic females scored higher than males on two of three CAT-Q subscales: Masking (partial <math>\eta^2 = .05</math>), and Assimilation (partial <math>\eta^2 = .06</math>), but not on the Compensation subscale. No differences were found between non-autistic males and females on any subscale. No differences were found between non-binary individuals and other genders in either autistic or non-autistic groups, although samples were underpowered. These findings support previous observations of greater camouflaging in autistic females than males, and demonstrate for the first time no self-reported gender difference in non-autistic adults.</p>

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## Gender Differences in Self-Reported Camouflaging in Autistic and Non-Autistic Adults

Laura Hull<sup>a</sup>, Meng-Chuan Lai<sup>b c d</sup>, Simon Baron-Cohen<sup>e</sup>, Carrie Allison<sup>e</sup>, Paula Smith<sup>e</sup>, K V Petrides<sup>e</sup> & William Mandy<sup>a</sup>

<sup>a</sup> Research Department of Clinical, Educational & Health Psychology, University College London, London, UK

<sup>b</sup> Centre for Addiction and Mental Health and The Hospital for Sick Children, Department of Psychiatry, University of Toronto, Toronto, Ontario, Canada

<sup>c</sup> Autism Research Centre, Department of Psychiatry, University of Cambridge, Cambridge, UK

<sup>d</sup> Department of Psychiatry, National Taiwan University Hospital and College of Medicine, Taipei, Taiwan

<sup>e</sup> London Psychometric Laboratory, University College London, London, UK

### Corresponding Author

Laura Hull

Department of Psychology, University College London, 26 Bedford Way, London, United Kingdom, WC1H 0AP

[laura.hull.14@ucl.ac.uk](mailto:laura.hull.14@ucl.ac.uk)

+44 02076795365



Gender Differences in Camouflaging

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All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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**Abstract**

Social camouflaging describes the use of strategies to compensate for and mask autistic characteristics during social interactions. A newly-developed self-reported measure of camouflaging (the Camouflaging of Autistic Traits Questionnaire; CAT-Q) was used in an online survey to measure gender differences in autistic ( $n = 306$ ) and non-autistic adults ( $n = 472$ ) without intellectual disability for the first time. Controlling for age and autistic-like traits, an interaction between gender and diagnostic status was found: autistic females demonstrated higher total camouflaging scores than autistic males (partial  $\eta^2 = .08$ ), but there was no camouflaging gender difference for non-autistic people. Autistic females scored higher than males on two of three CAT-Q subscales: Masking (partial  $\eta^2 = .05$ ), and Assimilation (partial  $\eta^2 = .06$ ), but not on the Compensation subscale. No differences were found between non-autistic males and females on any subscale. No differences were found between non-binary individuals and other genders in either autistic or non-autistic groups, although samples were underpowered. These findings support previous observations of greater camouflaging in autistic females than males, and demonstrate for the first time no self-reported gender difference in non-autistic adults.

**Keywords**

Autism, camouflaging, masking, compensation, gender differences, females, adult

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6 Social camouflaging is defined as the use of strategies to present a less visibly autistic  
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8 persona to others during a social interaction (Hull et al., 2017; Lai et al., 2011).  
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10 Camouflaging behaviours may be conscious or unconscious, and specific strategies as well as  
11  
12 their impact vary across individuals. Behaviours used to camouflage may also be a  
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14 consequence of the development of cognitive compensatory strategies (Livingston & Happé,  
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16 2017). Some common strategies include compensation for inherent autistic social differences,  
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18 such as consciously learning 'scripts' for regular social interactions, or implicitly developing  
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20 techniques to mask the appearance of autism, such as using speech patterns or sounds more  
21  
22 often shown by non-autistic people (Hull et al., 2017; Parish-Morris et al., 2017).  
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24 Camouflaging strategies are performed with the aim of reducing discrimination, smoothing  
25  
26 social interactions, and achieving success in employment or education (Hull et al., 2017),  
27  
28 although it still unknown to what extent these aims are achieved. Frequently-reported  
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30 consequences of camouflaging are exhaustion, loss of identity, and mental health difficulties  
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32 including suicidal thoughts (Bargiela, Steward, & Mandy, 2016; Cassidy, Bradley, Shaw, &  
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34 Baron-Cohen, 2018; Tierney, Burns, & Kilbey, 2016).  
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41 It has been suggested that females may experience and express their autism in different ways  
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43 to males, resulting in under-diagnosis of females; this is known as the 'female autism  
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45 phenotype' (Dworzynski, Ronald, Bolton, & Happé, 2012; Gould & Ashton-Smith, 2011;  
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47 Lai, Lombardo, Auyeung, Chakrabarti, & Baron-Cohen, 2015). The proposed female  
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49 phenotype may represent differences in quantity of behaviours (such as higher levels of  
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51 internalising disorders such as depression or anxiety; Lai et al., 2015) or in quality of  
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53 behaviours (such as differences in friendship experiences; Sedgewick, Hill, Yates, Pickering,  
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55 & Pellicano, 2015) between males and females at group levels, with significant individual  
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57 variation within each gender.  
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## Gender Differences in Camouflaging

Greater camouflaging of autistic characteristics, especially during clinical assessments or outside of the home, has been proposed as one way in which autistic girls and women may be missed by assessments that focus on 'typical' autism behaviours (Kopp & Gillberg, 1992). There may be many factors contributing to this gender-variant presentation. Biological or developmental differences between genders may lead to greater cognitive abilities related to camouflaging (Lehnhardt et al., 2013); while females may also be held to higher standards of social skills (Hull et al., 2017). Autistic females may also experience greater stigmatisation for appearing autistic than males, and this may relate to the intersection of multiple marginalised identities which create unique pressures for people who are both autistic and female, compared to either group separately (Cage & Troxell-Whitman, 2019). All these factors may interact to produce greater expectation, necessity, and ability to camouflage autism for females compared to males.

If gender differences in camouflaging in the hypothesised direction are found in autistic individuals, but not in non-autistic individuals, this supports the role of camouflaging in the female autism phenotype. In contrast, if similar gender differences are found in non-autistic males and females, this suggests that gender differences in camouflaging may reflect general social expectations for females to be more sociable and amenable than males (Kreiser & White, 2014). The present study is the first known to test these hypotheses by comparing self-reported camouflaging behaviours in a large sample of autistic and non-autistic adults. There has also been limited research into the extent of camouflaging in individuals who do not identify as either male or female; this study seeks to address this by including non-binary individuals in analyses of gender differences.

One approach to measuring camouflaging focuses on the 'discrepancy' between underlying social and cognitive abilities, and behavioural expression of autism/social abilities (Lai et al., 2017). Using this approach, camouflaging can only be measured in those identified as having

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3 difficulties in the areas of interest compared to the standards expected of neurotypical  
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5 individuals, since non-autistic individuals would theoretically have minimal discrepancy  
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7 scores (although see Livingston, Colvert, Bolton, & Happé, 2018, for evidence of  
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9 compensation for mentalizing difficulties in non-autistic individuals). Autistic women show a  
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11 greater discrepancy between internal autistic status and external behavioural presentation than  
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13 autistic men (Lai et al., 2017), and the level of which is associated with neural activation  
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15 related to self-referential cognition in autistic women specifically (Lai et al., 2018).  
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17 Behavioural assessment of camouflaging suggests that autistic girls use more linguistic  
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19 strategies to camouflage their social communication difficulties than boys (Boorse et al.,  
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21 2019; Parish-Morris et al., 2017). Autistic girls also tend to have higher parent-observed  
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23 adaptive difficulties and autistic characteristics when they present comparable levels of  
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25 clinician-rated autistic behaviours compared to autistic boys (Ratto et al., 2018).  
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29 An alternative approach which aims to directly identify and measure camouflaging strategies  
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31 allows for comparison between groups regardless of diagnostic status or perceived difficulties  
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33 (Hull et al., 2018). Following this 'observational/reflective' approach, Dean and colleagues  
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35 (2017) observed suggestive evidence of camouflaging in certain environments seen in autistic  
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37 girls, but not in autistic boys or non-autistic children. This suggests that gender differences in  
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39 camouflaging may be unique to autistic individuals, and that non-autistic males and females  
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41 do not differ in the extent to which they display any camouflaging behaviours. However, this  
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43 study focused only on a small number of children in a playground setting; these findings need  
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45 to be tested in larger samples across broader age ranges. In a study of adults, autistic men and  
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47 women were equally likely to spontaneously report using camouflaging strategies (Cage, Di  
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49 Monaco, & Newell, 2017).  
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53 Differences in camouflaging levels across genders may lead to differences in risk of mental  
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55 health problems and reduced wellbeing (Lai et al., 2017); it is therefore important to assess  
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## Gender Differences in Camouflaging

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3 how much autistic individuals of different genders are camouflaging in everyday life, and  
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5 compare this to camouflaging in non-autistic individuals. Camouflaging, like autistic traits,  
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7 likely exists on a continuum across the entire population. However, individuals with higher  
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9 levels of autistic characteristics are also likely to camouflage these more (Hull et al., 2018),  
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11 and so higher levels of camouflaging in one gender may simply reflect more autistic  
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13 characteristics to camouflage. As a supplementary analysis, and to thoroughly test the  
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15 hypothesis that autistic females camouflage more than males because of differences in social  
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17 expectation and/or behavioural presentation (Cage & Troxell-Whitman, 2019; Lai et al.,  
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19 2011), it is also important to control for autistic traits, separately to assessing the extent of  
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21 real-life camouflaging across genders. There may be age-related differences in the extent to  
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23 which individuals camouflage, based on social demands, experience, mental health, and other  
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25 factors (Cage & Troxell-Whitman, 2019; Hull et al., 2017), and so age should be included in  
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27 comparisons of camouflaging across groups and genders.  
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37 A new self-report measure of camouflaging, the Camouflaging Autistic Traits Questionnaire  
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39 (CAT-Q; Hull et al., 2018), has been developed based on autistic adults' lived experiences of  
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41 camouflaging to provide a measure of self-recognised intentions to camouflage, regardless of  
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43 behavioural outcome. The CAT-Q uses an observational/reflective approach to measuring  
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45 camouflaging. Items describing camouflaging strategies were developed from autistic adults'  
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47 self-reported camouflaging behaviours, and thus reflect behaviours experienced by autistic  
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49 individuals themselves, which may not all be identified through external observation. Unlike  
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51 other measures of camouflaging, the CAT-Q has demonstrated equivalency of psychometric  
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53 structure in males and females with and without an autism diagnosis (Hull et al., 2018), and,  
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55 therefore, can be used to compare camouflaging behaviours between these groups.  
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6 The present study had two key aims. First, this was the first study to test gender differences in  
7 self-reported camouflaging behaviours in both autistic and non-autistic adults, including  
8 people of non-binary gender. We hypothesised that autistic females would camouflage more  
9 than autistic males, following the predictions of the female autism phenotype hypothesis and  
10 in support of some previous research. Gender differences for non-binary autistic individuals'  
11 camouflaging, or that of any non-autistic participants, were not hypothesised as there has  
12 been no prior research examining this.

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23 Second, we also aimed to examine whether gender differences in camouflaging of autistic  
24 traits reflect underlying levels of autistic traits, and whether this is comparable across  
25 diagnostic groups. Autistic traits were added as a covariate in supplementary analyses, to  
26 determine whether any gender differences in real-life identified in autistic or non-autistic  
27 groups remained once variation in autistic traits between genders was controlled for.

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### Methods

#### Participants

Autistic and non-autistic participants were recruited through social media, through the  
[removed for review] database, and through word-of-mouth. Participants self-reported an  
official autism diagnosis from a qualified healthcare professional and were asked to detail the  
label of diagnosis (e.g. Autism, Asperger's Syndrome, Autism Spectrum Disorder), the age  
they were diagnosed, and the type of healthcare professional who diagnosed them. Those  
who reported being self-diagnosed were automatically excluded from the study and did not  
complete any further questions. Gender was measured by asking participants to report the  
gender they identified as (male, female or 'other gender'). Characteristics of the sample and  
mean scores on all variables are included in Table 1.

Gender Differences in Camouflaging

[INSERT TABLE 1 HERE]

Power analysis using G\*Power (Faul, Erdfelder, Lang, & Buchner, 2007) determined that a minimum sample of 54 per group would be necessary to detect medium-sized differences (partial  $\eta^2 = 0.5$ ) in an ANCOVA between autistic and non-autistic males, females, and non-binary individuals' camouflaging score while controlling for age and autistic-like traits. Individuals who identified as non-binary (neither male nor female;  $N = 43$ ; 16 with autism, 27 without autism) were included in analyses, but results are presented and discussed as preliminary only, as this sample was not well-powered enough to detect the predicted effect sizes. The final sample included 778 participants in total (see Table 1). An additional 53 individuals did not report their gender, and were not included in any analyses.

## Measures

### **Camouflaging of Autistic Traits Questionnaire (CAT-Q; Hull et al., 2018).**

This is a 25-item self-report questionnaire measuring strategies used to camouflage autistic traits and comprising three factors (Compensation, Masking, and Assimilation) which are summed up to produce a total score from 25 to 175, with higher scores representing greater levels of camouflaging. The CAT-Q has been validated in autistic and non-autistic male and female samples, and has demonstrated measurement equivalence across gender and diagnostic groups (Hull et al., 2018). Internal consistency in this sample was high ( $\alpha = 0.94$ ).

### **Broad Autism Phenotype Questionnaire (BAPQ; Hurley, Losh, Parlier, Reznick, & Piven, 2007).**

This is a 36-item self-report measure of traits associated with the broader autism phenotype (BAP). BAP characteristics are associated with greater genetic liability for autism, and are found across the population and at especially high levels in relatives of those with an autism diagnosis. Although it was designed as a measure of autistic-like traits in relatives of autistic





## Gender Differences in Camouflaging

small effect, values of .04 - .10 = moderate effect, and values above .14 = large effect), and Cohen's  $d$  used as a measure of effect size for planned comparison tests (where values under 0.4 = small effect, values of 0.5 – 0.7 = moderate effect, and values above 0.8 = large effect). Both effect sizes were interpreted following Cohen (1988; reported in Lenhard & Lenhard, 2016).

Firstly, main and interaction effects of gender and diagnostic group were examined while controlling for participant's age, through analysis of covariance (ANCOVA) for Total CAT-Q and MANCOVA for CAT-Q subscales. Univariate ANCOVAs were run separately in autistic and non-autistic groups to examine main effects of gender (with planned comparisons between each of the three genders when significant main effects were found), and in each gender to examine main effects of diagnostic group. These analyses aimed to identify the real-life levels of camouflaging across genders and groups.

Secondly, all analyses were repeated while controlling for participants' age and autistic traits (BAPQ total score). These analyses aimed to identify whether gender and group differences in camouflaging simply reflect differences in the amount of autistic characteristics that need to be camouflaged, or are a result of other factors.

## Results

Two-way ANOVA comparing age revealed main effects of diagnostic group (autistic participants were significantly older than non-autistic participants ( $F[1, 785] = 52.40, p < .001$ , partial  $\eta^2 = .06$ ), gender ( $F[2, 785] = 12.02, p < .001$ ), and an interaction between diagnostic group and gender ( $F[2, 785] = 4.64, p = .01$ ). Follow-up comparisons indicated that in the autistic sample, males were older than females ( $p < .001$ ) and non-binary individuals ( $p < .001$ ); there was no difference between females' and non-binary participants' ages. In the non-autistic sample, there were no gender differences in age. Autistic participants (mean

Gender Differences in Camouflaging

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1  
2  
3 BAPQ score = 4.30, SD = 0.71) had significantly higher levels of autistic-like traits than non-  
4  
5 autistic participants (mean BAPQ score = 3.18, SD = 0.74;  $t(777) = 20.55, p < .001$ ).  
6  
7

8  
9 Gender distributions on unadjusted Total CAT-Q scores in autistic and non-autistic samples  
10 are presented in Figure 1. Distributions on the CAT-Q subscales are presented in  
11  
12 Supplementary Figures 1a-c. 'Density' represents the proportion of participants in each group  
13 who scored at each level of the CAT-Q or its subscales; distributions for non-autistic samples  
14  
15 have been reflected to allow group comparison, and still represent positive values.  
16  
17  
18

19  
20  
21 [INSERT FIGURE 1 HERE]  
22

### 23 24 **Gender and Group differences with Age as a covariate**

25  
26 Figure 2 shows interactions between gender and diagnostic group for total and subscale CAT-  
27  
28 Q scores, when age was included as a covariate. See Table 1 for unadjusted means for all  
29  
30 variables.  
31  
32

33  
34 [INSERT FIGURE 2 HERE]  
35

#### 36 37 *Total CAT-Q score*

38  
39 The first ANCOVA revealed no main effect of gender ( $F[3,781] = 0.23, p = .63$ ), a significant  
40  
41 main effect of diagnostic group, with autistic participants scoring higher than non-autistic  
42  
43 participants ( $F[3,781] = 232.24, p < .001$ ), and an interaction between gender and diagnostic  
44  
45 group for Total CAT-Q score ( $F[3,781] = 26.27, p < .001$ ). The assumption of equality of  
46  
47 error variance was met for this model.  
48  
49

50  
51  
52 In order to further explore this interaction, follow-up ANCOVA in the autistic sample  
53  
54 revealed a main effect of gender ( $F[2, 306] = 9.67, p < .001, \text{partial } \eta^2 = .06$ ), with pairwise  
55  
56 comparisons indicating autistic females scored higher than males ( $p < .001, d = .65$ ), and no  
57  
58 difference between non-binary individuals and males or females. In the non-autistic sample,  
59  
60

1  
2  
3 follow-up ANCOVA demonstrated a main effect of gender ( $F[2, 478] = 8.98, p < .001,$   
4  
5 partial  $\eta^2 = .04$ ), with pairwise comparisons indicating non-autistic non-binary individuals  
6  
7 scored higher than females ( $p < .001, d = .73$ ) but not males. Non-autistic males did not score  
8  
9 differently to any other gender at the corrected alpha level.  
10

11  
12 Follow-up ANCOVAs were performed to examine diagnostic group differences separately  
13  
14 for each gender. Autistic females scored higher than non-autistic females ( $F[1, 437] = 218.95,$   
15  
16  $p < .001,$  partial  $\eta^2 = .34$ ). Autistic males scored higher than non-autistic males ( $F[1, 300] =$   
17  
18  $29.16, p < .001,$  partial  $\eta^2 = .09$ ). No difference was found between autistic and non-autistic  
19  
20 non-binary participants ( $F[1, 46] = 2.96, p = .09,$  partial  $\eta^2 = .06$ ).  
21  
22  
23

#### 24 25 *CAT-Q Subscales*

26  
27 Overall for the three subscales, MANCOVA revealed no main effect of gender ( $F[3, 781] =$   
28  
29  $1.70, p = .19$ ), a main effect of diagnostic group with autistic participants scoring higher than  
30  
31 non-autistic participants ( $F[3, 781] = 241.12, p < .001$ ), and an interaction between gender  
32  
33 and diagnostic group ( $F[3, 781] = 15.71, p < .001$ ). The assumption of equality of covariance  
34  
35 matrices was not met for this model, therefore Pillai's Trace was used as a robust multivariate  
36  
37 statistic.  
38  
39  
40

41  
42 Follow-up ANCOVA in the autistic sample revealed a significant multivariate effect of  
43  
44 gender (Pillai's Trace = .02,  $F[6, 604] = 4.23, p < .001,$  partial  $\eta^2 = .04$ ), and univariate  
45  
46 effects of gender in the Masking ( $F[2, 306] = 6.29, p = .002,$  partial  $\eta^2 = .04$ ) and  
47  
48 Assimilation ( $F[2, 306] = 783.25, p < .001,$  partial  $\eta^2 = .06$ ) subscales. No main effect of  
49  
50 gender was found for the Compensation subscale when adjusting for the corrected alpha ( $F[2,$   
51  
52  $306] = 4.07, p = .02,$  partial  $\eta^2 = .03$ ). Pairwise comparisons were conducted to assess gender  
53  
54 differences in the Masking and Assimilation subscales. Autistic females scored higher than  
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## Gender Differences in Camouflaging

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2  
3 autistic males on the Masking subscale ( $p = .001$ ,  $d = .43$ ) and the Assimilation subscale ( $p <$   
4  
5  $.001$ ,  $d = .51$ ). No other differences were significant at the corrected alpha level.  
6  
7

8  
9 In the non-autistic sample, follow-up ANCOVA demonstrated a significant multivariate  
10 effect of gender (Pillai's Trace = 0.44,  $F[6, 948] = 3.52$ ,  $p = .002$ , partial  $\eta^2 = .02$ ), and  
11 univariate effect of gender for the Compensation subscale only ( $F[2, 478] = 9.21$ ,  $p < .001$ ,  
12 partial  $\eta^2 = .04$ ). Pairwise comparisons revealed that non-autistic males scored higher than  
13 females ( $p = .005$ ,  $d = .23$ ), and that non-binary participants scored higher than females ( $p <$   
14  $.001$ ,  $d = .72$ ) on Compensation.  
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22  
23 Follow-up ANCOVAs were conducted to examine the effect of diagnostic group separately  
24 in each gender. A main effect of diagnostic group was found in females (Pillai's Trace = .43,  
25  $F[3, 433] = 108.60$ ,  $p < .001$ , partial  $\eta^2 = .43$ ), with autistic females scoring higher than non-  
26 autistic females on Compensation ( $F[1, 437] = 212.28$ ,  $p < .001$ , partial  $\eta^2 = .33$ ), Masking  
27 ( $F[1, 437] = 24.47$ ,  $p < .001$ , partial  $\eta^2 = .05$ ), and Assimilation subscales ( $F[1, 437] =$   
28  $262.38$ ,  $p < .001$ , partial  $\eta^2 = .38$ ). A main effect of diagnostic group was also found in males  
29 (Pillai's Trace = .25,  $F[3, 296] = 32.82$ ,  $p < .001$ , partial  $\eta^2 = .25$ ), and autistic males scored  
30 higher than non-autistic males on the Compensation ( $F[1, 300] = 37.89$ ,  $p < .001$ , partial  $\eta^2 =$   
31  $.11$ ) and Assimilation subscales ( $F[1, 300] = 52.06$ ,  $p < .001$ , partial  $\eta^2 = .15$ ). In non-binary  
32 participants, no main effect of diagnostic group was found at the corrected significance level  
33 (Pillai's Trace = .23,  $F[3, 42] = 4.20$ ,  $p = .01$ , partial  $\eta^2 = .23$ ).  
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**Gender differences with Age and Autistic Traits as covariates***Total CAT-Q score*

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51  
52 The first ANCOVA revealed no main effect of gender ( $F[3,737] = 0.01$ ,  $p = .99$ ), a significant  
53 main effect of diagnostic group with autistic participants scoring higher than non-autistic  
54 participants ( $F[3,737] = 11.25$ ,  $p < .001$ ), and an interaction between gender and diagnostic  
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## Gender Differences in Camouflaging

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group for Total CAT-Q score ( $F[3,737] = 12.87, p < .001$ ). The assumption of equality of error variance was met for this model.

Figure 3 shows interactions between gender and diagnostic group for total and subscale CAT-Q scores, when age and autistic-like traits were included as covariates.

[INSERT FIGURE 3 HERE]

Follow-up ANCOVA in the autistic sample revealed a main effect of gender ( $F[2, 299] = 6.98, p = .001, \text{partial } \eta^2 = .05$ ), with pairwise comparisons indicating autistic females scored higher than males ( $p < .001, d = .47$ ), and no difference between non-binary individuals and males or females. In the non-autistic sample, follow-up ANCOVA demonstrated no main effect of gender ( $F[2, 442] = 2.61, p = .07, \text{partial } \eta^2 = .01$ ).

Follow-up ANCOVAs were performed to examine diagnostic group differences separately for each gender. Autistic females scored higher than non-autistic females ( $F[1, 415] = 14.98, p < .001, \text{partial } \eta^2 = .04$ ). No difference was found between autistic and non-autistic males ( $F[1, 283] = 0.12, p = .73$ ) or non-binary participants ( $F[1, 39] = 0.20, p = .65$ ).

*CAT-Q Subscales*

Overall for the three subscales, MANCOVA revealed no main effect of gender ( $F[3, 735] = 2.23, p = .08$ ), a main effect of diagnostic group with autistic participants scoring higher than non-autistic participants ( $F[3, 735] = 36.00, p < .001$ ), and an interaction between gender and diagnostic group ( $F[3, 735] = 7.70, p < .001$ ). The assumption of equality of covariance matrices was not met for this model, therefore Pillai's Trace was used as a robust multivariate statistic.

Follow-up ANCOVA in the autistic sample revealed a significant multivariate effect of gender (Pillai's Trace = .08,  $F[6, 588] = 3.81, p = .001, \text{partial } \eta^2 = .04$ ), and univariate



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2  
3 effects of gender in the Masking ( $F[2, 299] = 6.20, p = .002, \text{partial } \eta^2 = .04$ ) and  
4  
5 Assimilation ( $F[2, 299] = 7.50, p = .001, \text{partial } \eta^2 = .05$ ) subscales. Pairwise comparisons  
6  
7 were conducted to assess gender differences in the Masking and Assimilation subscales.  
8  
9 Autistic females scored higher than autistic males on the Masking subscale ( $p = .001, d = .44$ )  
10  
11 and the Assimilation subscale ( $p < .001, d = .40$ ). No other differences were significant at the  
12  
13 corrected alpha level.  
14  
15

16  
17  
18 In the non-autistic sample, follow-up ANCOVA demonstrated no significant multivariate  
19  
20 effect of gender (Pillai's Trace = 0.25,  $F[6, 874] = 1.86, p = .08, \text{partial } \eta^2 = .01$ ) and so  
21  
22 further analyses were not performed.  
23  
24

25  
26 Follow-up ANCOVAs were conducted to examine the effect of diagnostic group separately  
27  
28 in each gender. A main effect of diagnostic group was found in females (Pillai's Trace = .07,  
29  
30  $F[3, 410] = 9.99, p < .001, \text{partial } \eta^2 = .07$ ), with autistic females scoring higher than non-  
31  
32 autistic females on Compensation ( $F[1, 415] = 28.59, p < .001, \text{partial } \eta^2 = .07$ ) only. A main  
33  
34 effect of diagnostic group was also found in males (Pillai's Trace = .07,  $F[3, 278] = 6.99, p <$   
35  
36  $.001, \text{partial } \eta^2 = .07$ ), but diagnostic group differences on each subscale were not significant  
37  
38 at the corrected alpha level. In non-binary participants, no main effect of diagnostic group  
39  
40 was found (Pillai's Trace = .18,  $F[3, 37] = 2.66, p = .06, \text{partial } \eta^2 = .18$ ).  
41  
42  
43

#### 44 **Discussion**

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47 This was the first study to compare self-reported camouflaging behaviours between autistic  
48  
49 and non-autistic men, women, and non-binary people.  
50

51  
52  
53 A consistent finding was that autistic females had higher camouflaging scores than autistic  
54  
55 males. Effect sizes were moderate, with the largest differences found for Total CAT-Q. This  
56  
57 supports our hypothesis that autistic females camouflage more than males, and suggests that  
58  
59 autistic women may use more masking strategies, and experience greater pressure than men  
60

## Gender Differences in Camouflaging

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2  
3 to adapt their behaviours in order to assimilate with others. No gender difference was found  
4  
5 on the Compensation subscale, suggesting autistic individuals of all genders may use  
6  
7 compensatory strategies to a similar extent.  
8  
9

10 Non-binary autistic people had higher total CAT-Q scores than females when controlling for  
11  
12 age only, suggesting that these individuals may be at particular risk of the negative outcomes  
13  
14 associated with camouflaging. However, this difference was not found when autistic traits  
15  
16 were controlled for, suggesting that their higher levels of camouflaging may arise because  
17  
18 they have more autistic traits to camouflage than females. However, the number of autistic  
19  
20 non-binary participants in this sample was very small, and so the analyses were likely  
21  
22 underpowered to detect small group differences.  
23  
24  
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26

27 In contrast, gender differences in non-autistic individuals were minimal, and were not  
28  
29 maintained when autistic traits were controlled for. Non-autistic males reported slightly  
30  
31 higher levels of camouflaging than non-autistic females, but this difference was not  
32  
33 maintained when we controlled for levels of autistic traits. The implication is that, compared  
34  
35 to non-autistic females, non-autistic males may use slightly more camouflaging, reflecting the  
36  
37 fact that they have somewhat higher levels of autistic traits (Robinson et al., 2011). Non-  
38  
39 binary non-autistic individuals had higher Total CAT-Q and Compensation scores than  
40  
41 females, which may be accounted for by their higher mean levels of autistic traits (see Table  
42  
43 1), as these differences were not found when controlling for autistic traits. Again, however,  
44  
45 the sample size was underpowered to detect small differences between non-binary and other  
46  
47 participants.  
48  
49  
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51

52 Consistent group differences were found between autistic and non-autistic females, which  
53  
54 were maintained when controlling for autistic traits. Again, this suggests that there is an  
55  
56 interaction between being female and being autistic which produces greater camouflaging  
57  
58  
59  
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1  
2  
3 than the simple additive effects of each separately. Interestingly, differences between autistic  
4 and non-autistic males were not maintained when autistic traits were controlled for,  
5  
6 suggesting that males across diagnostic groups camouflage their autistic characteristics to a  
7  
8 similar extent (but that autistic males have higher levels of autistic traits, and so use more  
9  
10 camouflaging strategies in real life). No differences between autistic and non-autistic non-  
11  
12 binary participants were found, which is likely to reflect the small samples of each.  
13  
14  
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17  
18 Overall, the pattern of gender differences suggests a relatively similar use of specific  
19  
20 compensatory strategies in autistic males, females, and non-binary people (as measured by  
21  
22 similar scores on the Compensation subscale), but greater use of specific Masking and  
23  
24 Assimilation strategies by females. One explanation for this may be differences in the  
25  
26 gendered experiences of autistic females and males, as a product of both cultural gender  
27  
28 norms and being held to the standards of typically developing females and males respectively  
29  
30 (Cage & Troxell-Whitman, 2019). Kreiser and White (2014) describe an interaction between  
31  
32 cultural, inter- and intra-personal, and biological factors affecting gender and individual  
33  
34 development, which they suggest may produce variation in both innate autistic experience  
35  
36 and external autistic presentation. Autistic females may perceive greater expectations to be  
37  
38 acting similarly to typically developing peers than are felt by autistic males (Bargiela,  
39  
40 Steward & Mandy, 2016; Dean et al., 2014), and so may camouflage to a greater extent in  
41  
42 order to try and fit in (Kreiser & White, 2014; Tierney et al., 2016). This pattern of  
43  
44 difference was not found in the non-autistic sample. This indicates that although the kind of  
45  
46 intention and behavioural strategies measured by the CAT-Q are utilized across autistic and  
47  
48 non-autistic adults, impact of gender (and theoretically, gendered contexts) is more evident  
49  
50 and unique in the autistic compared to non-autistic population.  
51  
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58 Participants in this study were mostly European or North American and in early/middle  
59  
60 adulthood on average, and so mostly grew up in Westernised cultures during the 1970s, 80s,

## Gender Differences in Camouflaging

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2  
3 and 90s. Gender-based stereotypes and rigid gender binaries during childhood and  
4  
5 adolescence may have contributed to this greater pressure to camouflage autistic  
6  
7 characteristics for autistic females than males. It will be important for future research to  
8  
9 understand why such impact is more obvious in the autistic than the neurotypical population  
10  
11 (e.g., do autistic people of this age conform more to gender norms than their neurotypical  
12  
13 peers?) and whether the same will be found in the younger generations, for whom  
14  
15 conventional, binary gender norms are relaxing. It may be that the combined identities of  
16  
17 being autistic and female result in greater stigmatisation of difference, which leads to more  
18  
19 efforts to fit in for autistic women than other groups (Cage & Troxell-Whitman, 2019). As  
20  
21 such, it will be a task to look at autistic individuals of all genders who develop their (autistic)  
22  
23 identities under the current, more fluid conceptions of gender and neurodiversity in many  
24  
25 Westernised cultures (although it remains to be seen as to whether gender equality in society  
26  
27 impacts social conceptions of gender; MacPhee & Prendergast, 2019; Prendergast &  
28  
29 MacPhee, 2018), and see whether the observed gender differences remain.  
30  
31  
32  
33  
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35

36 Gender differences in the autistic sample remained significant even when controlling for  
37  
38 autistic-like traits, suggesting that higher levels of camouflaging in females are not due to  
39  
40 having more autistic traits to camouflage than males, but due to greater extent of  
41  
42 camouflaging of the autistic traits they do have, perhaps because of greater social  
43  
44 expectations for females than males (Bargiela, Steward & Mandy, 2016). Autistic women  
45  
46 may experience unique and more extreme pressures than either autistic men or typically  
47  
48 developing women, in part because of the intersection of their identities as neurodivergent  
49  
50 and female (Cage & Troxell-Whitman, 2019), which may lead to differences in behavioural  
51  
52 expression of autistic characteristics compared to the 'typical' male presentation. This  
53  
54 supports suggestions that camouflaging forms part of the female phenotype of autism (Head,  
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## Gender Differences in Camouflaging

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3 McGillivray, & Stokes, 2014; Kirkovski, Enticott, & Fitzgerald, 2013; Lai et al., 2015;  
4  
5  
6 Lehnhardt et al., 2015).

7  
8  
9 Camouflaging of autistic traits may be more predominant in autistic females, and may  
10  
11 partially account for the missed and later diagnosis of autism found for many females  
12  
13 (Duvekot et al., 2017; Dworzynski et al., 2012; Shattuck et al., 2009). Previous research has  
14  
15 also suggested that camouflaging may lead to mental health difficulties amongst autistic  
16  
17 females, particularly anxiety and exhaustion related to the pressures of maintaining the  
18  
19 'façade' (Bargiela et al., 2016; Tierney et al., 2016), and suicidal thoughts (Cassidy et al.,  
20  
21  
22 2018).  
23  
24

25  
26 Our findings contradict those by Cage and Troxell-Whitman (2019), who did not find  
27  
28 difference between autistic males and females using the total CAT-Q score. These  
29  
30 researchers did not control for autistic traits, therefore it is possible that male participants in  
31  
32 their study had higher levels of autistic traits to camouflage than females, resulting in  
33  
34 comparable overall camouflaging scores. Further research in a range of broader samples is  
35  
36 necessary to determine the exact nature and size of any gender differences in camouflaging,  
37  
38 using a range of methodologies. We would also suggest that, once the literature reaches a  
39  
40 sufficient size, meta-analysis is the best way to produce a definitive answer on the direction  
41  
42 and size of gender differences in camouflaging using a variety of samples and methods.  
43  
44  
45 However, autistic males in the current study camouflaged at significantly higher levels than  
46  
47 non-autistic males, and at equivalent levels to autistic non-binary individuals, when  
48  
49 controlling for age only. These findings support previous research arguing that camouflaging  
50  
51 is not an exclusively female phenomena (Cage et al., 2017; Lai et al., 2017; Livingston et al.,  
52  
53 2018). As demonstrated in the first set of analysis, controlling only for age, autistic males and  
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55  
56 non-binary individuals are also likely to experience the negative consequences associated  
57  
58 with camouflaging, and there may even be greater impact on mental health for men than  
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60

Gender Differences in Camouflaging

women, possibly due to reduced experience of camouflaging and other gender-related demands (Hull et al., 2017; Lai et al., 2017).

### **Limitations and Strengths**

A significant limitation of this study is that only adults who were able to access and answer the online questionnaire were included in the study. While the online nature of this study enabled participation by individuals who prefer written to spoken language, there was no representation of autistic individuals who may be unable to reflect upon and express their behaviours through written English. Furthermore, the average age of autism diagnosis was 31.92 years, suggesting that these findings may be limited to individuals who are diagnosed in adulthood. These individuals may be more likely than others to camouflage their autism, having remained unidentified for so long. Therefore, it is still an open question as to whether the findings could be generalised to autistic people who were diagnosed earlier in life (e.g. in childhood).

In addition, participants' autistic status was based on self-reported disclosure, and was not independently verified. However, participants were also asked to give details of who gave them the diagnosis, and those who reported being diagnosed by someone other than a clinician or healthcare team were excluded from the study. More information about participants' diagnostic experiences, and other individual characteristics such as ethnicity, is important for future research to understand factors affecting variability in camouflaging.

Although we have reported all results with regards to non-binary participants, we emphasise that both autistic and non-autistic samples of non-binary individuals were underpowered to detect the expected effect sizes. This may account for the non-significance of most results regarding non-binary participants. We therefore interpret these results with caution, and suggest that further study with larger samples of non-binary individuals is conducted before

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2  
3 any conclusions are drawn regarding non-binary camouflaging levels. Additionally, the CAT-  
4  
5 Q has not been psychometrically validated in non-binary populations, therefore it may not be  
6  
7 an appropriate measure to use with this group. However, as a relatively large proportion of  
8  
9 autistic individuals identify as non-binary (Cooper, Smith, & Russell, 2018; Dewinter, De  
10  
11 Graaf & Begeer, 2017), we believe these results are an important first step to learning more  
12  
13 about the mechanisms and consequences of camouflaging across all genders.  
14  
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16  
17  
18 Despite the aforementioned limitations, this study had multiple strengths. First, it is unique in  
19  
20 that a psychometrically validated measure was used to assess and compare camouflaging  
21  
22 behaviours between autistic and non-autistic males, females, and non-binary individuals.  
23  
24 Second, it is based on the largest sample used to assess gender differences in camouflaging so  
25  
26 far, strengthening previous findings of greater camouflaging in autistic females. Third, by  
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28 controlling for age and autistic-like traits we demonstrate that self-reported camouflaging is  
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30 not exclusively related to the development of typical social skills, and that gender differences  
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32 in camouflaging exist for autistic individuals only.  
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37 The findings suggest that autistic women camouflage their autistic traits to a greater degree  
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39 than autistic men, and therefore clinicians and other service providers should consider  
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41 camouflaging when assessing women's autistic characteristics and their impact on daily  
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43 functioning and wellbeing. However, autistic men and non-binary individuals also  
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45 camouflage their autism at high levels, and should also be included in research looking at the  
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47 consequences of camouflaging. Validated measures such as the CAT-Q may be used by  
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49 individuals and in clinical settings to identify relevant camouflaging strategies and adapt  
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51 behaviour as necessary to minimise negative outcomes.  
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#### 54 55 56 **Acknowledgements** 57 58 59 60

Gender Differences in Camouflaging

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For Peer Review



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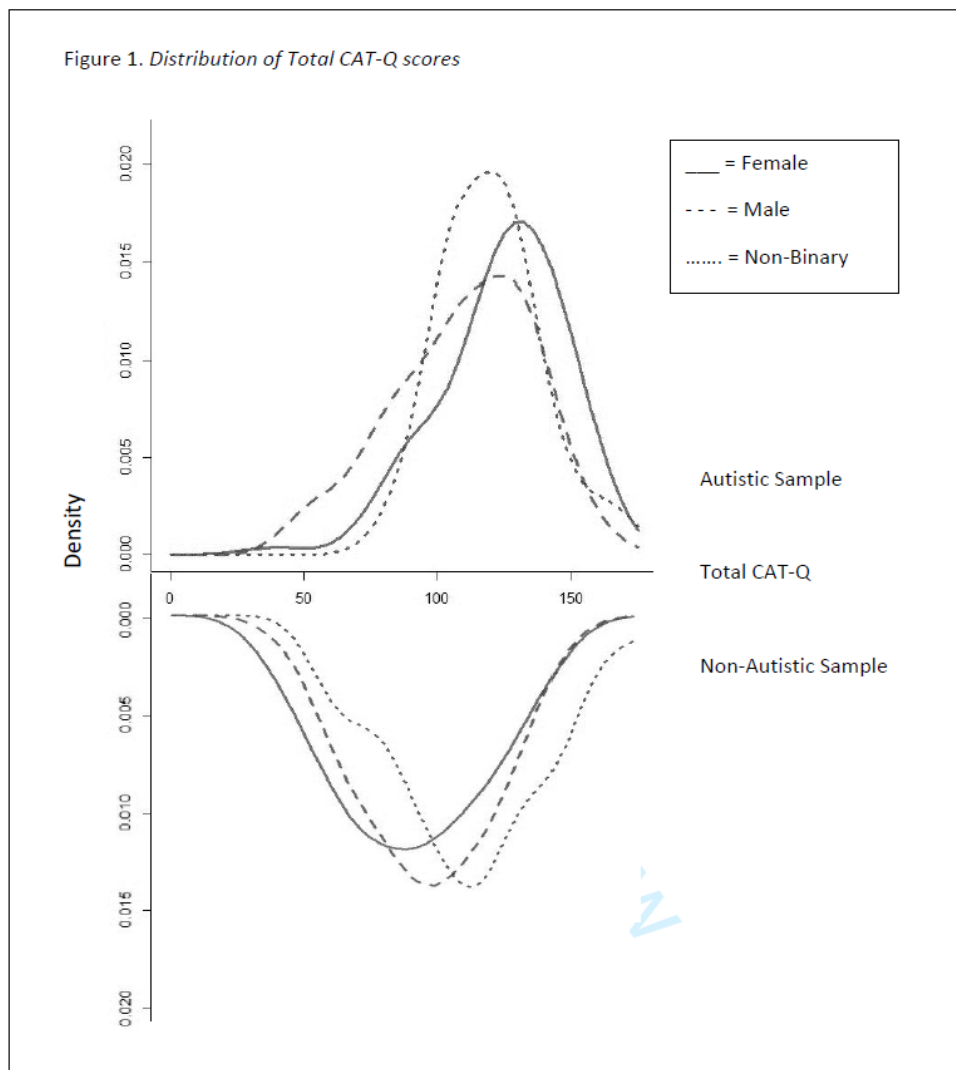
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	Total Sample	Autistic Sample			Non-Autistic Sample		
		Female	Male	Non-Binary	Female	Male	Non-Binary
N	778	182	108	16	252	193	27
Age (SD)	34.56 (14.89)	39.91 (12.75)	46.68 (13.98)	33.50 (11.74)	29.86 (13.40)	30.94 (14.78)	26.52 (10.74)
Highest level of education (%)		Secondary: 36 Undergraduate: 30 Postgraduate: 33 Not Specified: 1	Secondary: 35 Undergraduate: 28 Postgraduate: 35 Not Specified: 2	Secondary: 66 Undergraduate: 17 Postgraduate: 17 Not Specified: 0	Secondary: 47 Undergraduate: 28 Postgraduate: 25 Not Specified: 0	Secondary: 47 Undergraduate: 30 Postgraduate: 23 Not Specified: 0	Secondary: 86 Undergraduate: 7 Postgraduate: 7 Not Specified: 0
Nationality (%)		British: 53 N. American: 23 European: 15 Other: 6 Not Specified: 3	British: 63 N. American: 20 European: 8 Other: 8 Not Specified: 1	British: 38 N. American: 44 European: 12 Other: 6 Not Specified: 0	British: 43 N. American: 28 European: 17 Other: 8 Not Specified: 4	British: 48 N. American: 29 European: 12 Other: 6 Not Specified: 5	British: 37 N. American: 40 European: 3 Other: 13 Not Specified: 7
ASC Diagnosis (%)	N.A.	Asperger's: 67 Autism: 19 ASD: 11 PDD-NOS: 3	Asperger's: 74 Autism: 18 ASD: 6 PDD-NOS: 2	Asperger's: 56 Autism: 19 ASD: 25	N.A.	N.A.	N.A.
Age at ASC Diagnosis (SD)	N.A.	34.07 (13.13)	37.92 (15.99)	23.76 (13.08)	N.A.	N.A.	N.A.
Who gave ASC Diagnosis (%)	N.A.	Psychologist: 53 Psychiatrist: 35 Other doctor <sup>a</sup> : 2 Other <sup>b</sup> : 9	Psychologist: 53 Psychiatrist: 36 Other doctor <sup>a</sup> : 3 Other <sup>b</sup> : 8	Psychologist: 44 Psychiatrist: 50 Other <sup>b</sup> : 6	N.A.	N.A.	N.A.

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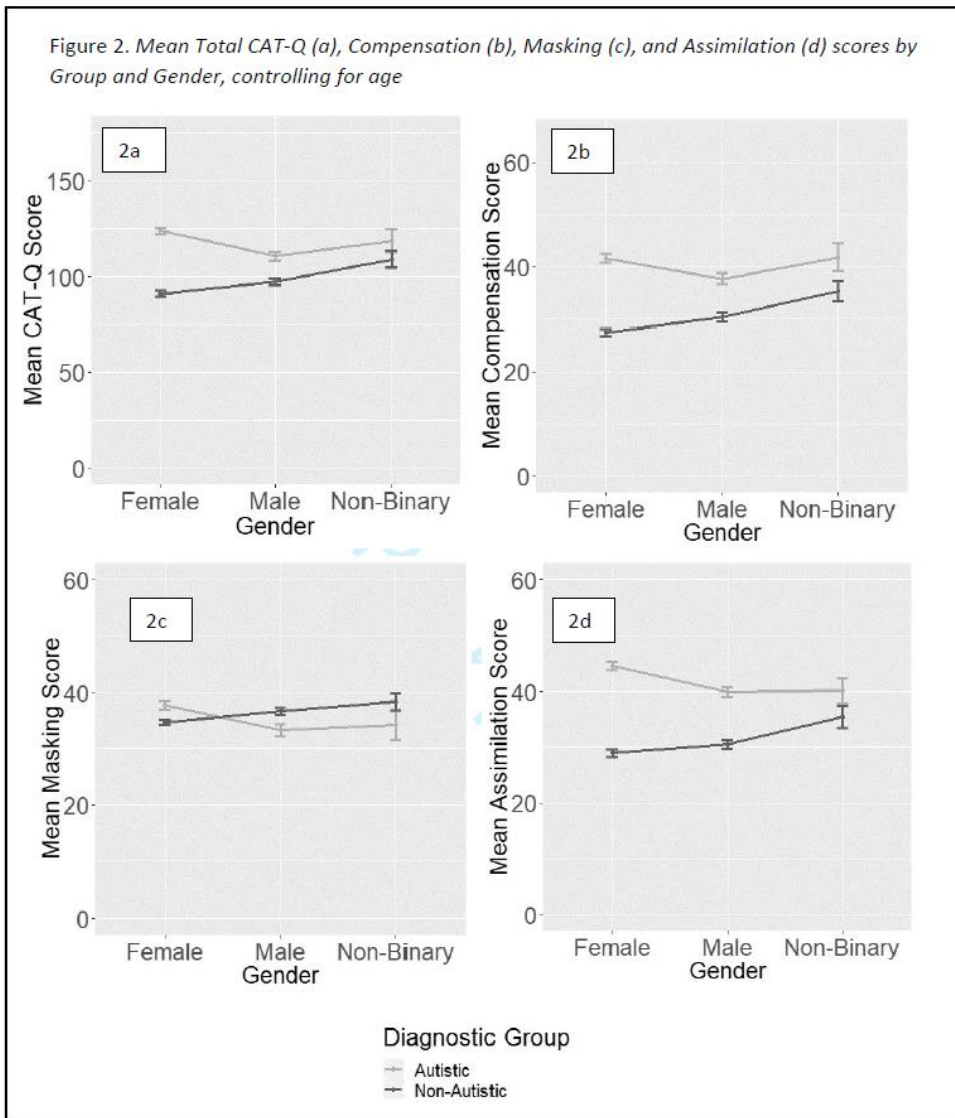
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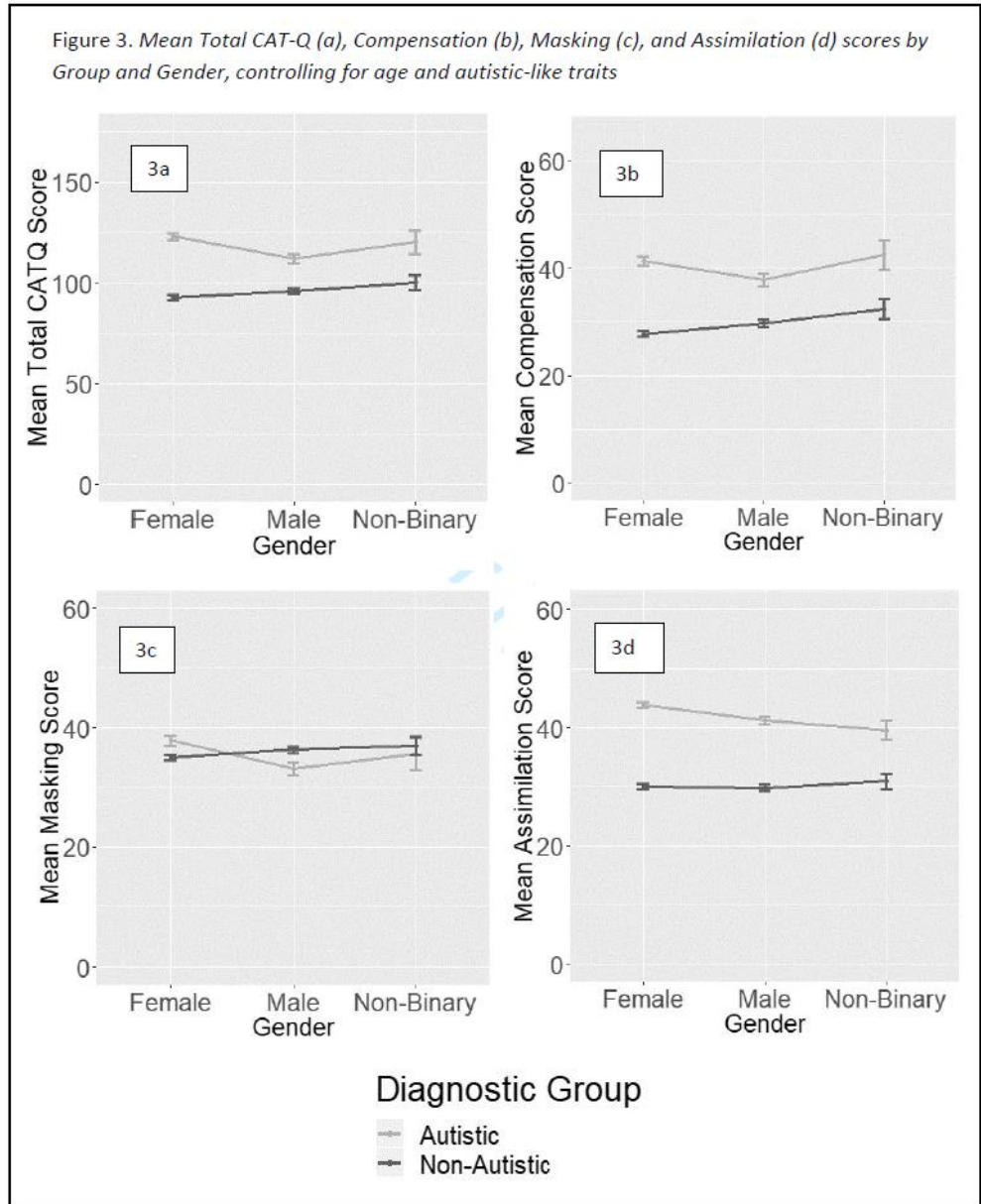
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Figure 2. Mean Total CAT-Q (a), Compensation (b), Masking (c), and Assimilation (d) scores by Group and Gender, controlling for age

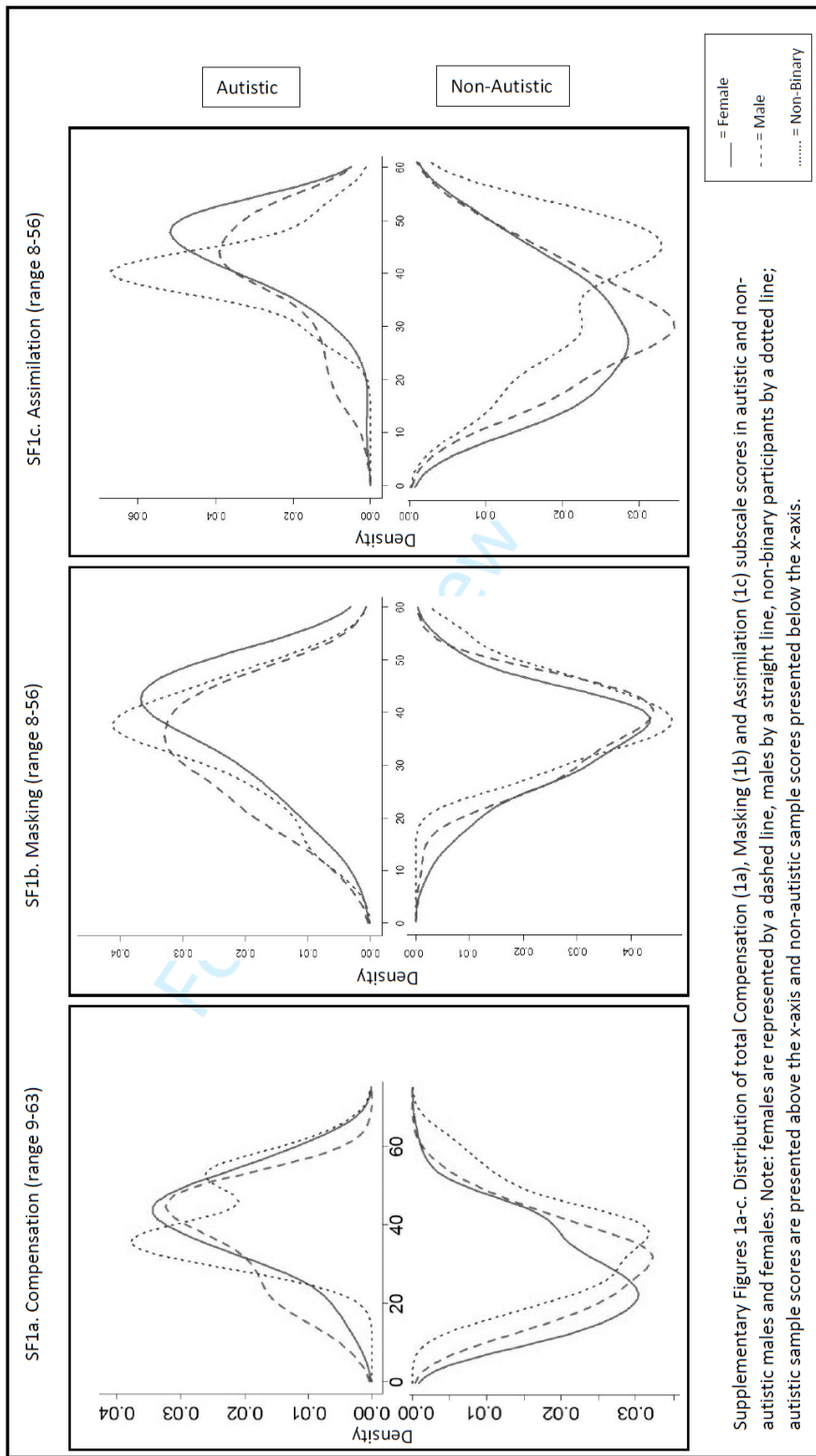




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Supplementary Figures 1a-c. Distribution of Compensation (SF1a), Masking (SF1b) and Assimilation (SF1c) subscale scores in Autistic (above x-axis) and Non-Autistic (below x-axis) samples



Supplementary Figures 1a-c. Distribution of total Compensation (1a), Masking (1b) and Assimilation (1c) subscale scores in autistic and non-autistic males and females. Note: females are represented by a dashed line, males by a straight line, non-binary participants by a dotted line; autistic sample scores are presented above the x-axis and non-autistic sample scores presented below the x-axis.

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