University of Southampton

Faculty of Environmental and Life Sciences

School of Psychology

Sex/Gender Differences in Social Interaction, Social Communication and Camouflaging in Children on the Autistic Spectrum

by

Henry Wood-Downie

Thesis for the degree of Doctorate of Educational Psychology

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Abstract

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A growing body of evidence suggests that autism spectrum disorder (ASD) manifests differently in females than males, including in the domains of social interaction and communication, and that there may be a female specific phenotype of the condition. Previous research investigating sex/gender differences in these domains has predominantly been based on 'gold-standard' instruments which may not be sensitive to the female phenotype. In addition, studies have often failed to include typically developing males and females, and are therefore unable to account for sex/gender differences found in the general population. Accordingly, Chapter 1 presents a systematic review and meta-analysis of 14 studies that investigated sex/gender differences in social communication and interaction in autistic and neurotypical males and females. In order to overcome potential diagnostic bias against females, only studies that reported fine-grained subdomains of the DSM-5 ASD criteria, not measured used diagnostic instruments were included. It was found that females with autism had significantly better social interaction and communication than males with autism, which was reflective of sex/gender differences for neurotypical individuals. In addition, both neurotypcial males and females had significantly better social interaction and communication than autistic males and females, though this difference was smaller for females, which sheds light on social camouflaging and the underecogniton of autism in females.

Chapter 2 presents an empirical investigation of sex/gender differences in social camouflaging and compensation. Children and adolescents aged 8-14 years completed a drawing task with a research in order to measure their social reciprocity, as well as a theory

of mind task. The final sample comprised 22 males with autism/high autistic traits, 18 females with autism/high autistic traits, 22 neurotypical males, and 22 neurotypical females. Females with autism/high autistic traits were found to have significantly higher social reciprocity than males with autism/high autistic traits, but very similar levels of theory of mind. In addition, females with autism/high autistic traits had almost identical levels of social reciprocity to neurotypical females, whereas males with autism/high autistic traits had significantly lower social reciprocity than neurotypical males. Overall, these results provide evidence of greater levels of social camouflaging and compensation in autistic females than males, which may delay intervention for the social difficulties they experience.

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Research Thesis: Declaration of Authorship

Print name:	HENRY WOOD-DOWNIE

Title of thesis:	Sex/Gender Differences in Social Interaction, Social Communication and Camouflaging in Children on the Autistic Spectrum

I declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;

None of this work has been published before submission

Signature:		Date:	

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Definitions and Abbreviations

AD	Autistic disorder
ADI-R	Autism Diagnostic Interview-Revised
ADOS	Autism Diagnostic Observation Schedule
ANOVA	Analysis of variance
ANCOVA	Analysis of covariance
APA	American Psychiatric Association
AS	Asperger's syndrome
ASC	Autism Spectrum Condition
ASD	Autism Spectrum Disorder
AQ	Autism-Spectrum Quotient Questionnaire
AXIS	Appraisal tool for cross-sectional studies
CARS	Childhood Autism Rating Scale
CAT-Q	Camouflaging Autistic Traits Questionnaire
Chi^2	Chi squared
CI	Confidence interval
CPQ	Child Play Questionnaire
d	Cohen's d
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders (4th ed.)
DSM-IV-TR	Diagnostic and Statistical Manual of Mental Disorders (4th ed., text rev.)
DSM-5	Diagnostic and Statistical Manual of Mental Disorders (5^{th} ed.)
F	F statistic
FS	Friendship Survey
FQ	Friendship Questionnaire
FQS	Friendships Qualities Scale

HFA	High functioning autism
I^2	I squared
ICD-10	International Classification of Diseases (10th ed.)
IDT	Interactive Drawing Test
IMS	Interpersonal motor synchrony
IQ	Intelligence quotient
M	Mean
MCDD	Multiple complex developmental disorder
n	Sample of population
N	Total population
p	p-value
PDD-NOS	Pervasive developmental disorder, not otherwise specified
PTSR	Phase synchronization time ratio
RMET-C	Reading the Mind in the Eyes Test, Child's Version
POPE	Playground Observation of Peer Engagement
Q-Q	Quantile-quantile
r	Pearson's correlation coefficient
RPEQ	Revised Peer Experiences Questionnaire
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RRBIAs	Restricted, repetitive patterns of behavior, interests, or activities
SCDC	Social and Communication Disorders Checklist
SDQ	Strengths and Difficulties Questionnaire
SENCo	Special Educational Needs Coordinators
SCQ	Social communication questionnaire
SD	Standard deviation

SE	Standard error
SMD	Standardised mean difference
SRS	Social Responsiveness Scale
S-W test	Shapiro-Wilks test
t	T statistic
Tau^2	Tau squared
TD	Typically Developing
WASI-II	Wechsler Abbreviated Scale of Intelligence, Second Edition
χ^2	Chi squared
Z	Z score
η^2_P	Partial-eta squared

Chapter 1 Sex/gender differences in social interaction and communication in autistic and neurotypical males and females

1.1 Introduction

Autism spectrum condition – or autism - is a neurodevelopmental disability characterised by 'persistent impairment in reciprocal social communication and social interaction, and restricted, repetitive patterns of behaviour, interests or activities' (American Psychiatric Association [APA], 2013, p. 53). Autism is generally believed to be a dimensional construct, with traits distributed amongst the general population (Constantino, 2011). As a diagnosis is necessarily categorical, however, individuals require traits beyond a specified cut-off point, as well as functional difficulties, to receive a clinical diagnosis (APA, 2013). In addition to the core characteristics, autistic individuals[1] experience variation across a number of associated features encompassing the cognitive (e.g. executive functioning difficulties), emotional (e.g., anxiety), behavioural (e.g., challenging behaviours) , and sensory (e.g., hyper- and hypo-sensitivities) domains (Volkmar, Paul, Klin, & Cohen, 2005).

Roughly 1-2% of the population have a diagnosis of autism, and this diagnosis is made more frequently for males than females (Baio, 2014). The reported gender ratio varies depending on the specific demographics of the participants included in the study, such as which country they live in and their IQ, with an average of around four males to every female (Kreiser & White, 2014). However, population based studies, which screen all participants for autistic traits (as opposed to only including those who have been referred to or received a formal diagnosis via clinical services), have found the gender ratio to be closer to three males to every female (Loomes, Hull, and Mandy, 2017; Sun, Allison, Auyeung, Baron-Cohen, & Brayne, 2014). The fact that gender ratio is smaller in population-based studies than clinical samples suggests there may be a bias against girls coming to clinical attention (Hull & Mandy, 2017). This bias may have stemmed from the very first conceptualisations of autism; Kanner's original group of children contained only

[1] In accordance with research suggesting there is no one preferred way of describing autism within the broader autism community, both person-first (e.g., individual with autism) and identity-first (e.g., autistic female) will be used within this paper (Kenny et al., 2016).

3 females, compared to 11 males (Kanner, 1971). In addition, no girls were included in Asperger's first four cases (Asperger's 1944).

1.1.1 Sex/Gender Bias in Autism Diagnostic Criteria and Instruments

It is important to acknowledge that sex and gender are distinct constructs, with sex referring to 'one's biological status as either male or female', whereas genders refers to the 'socially constructed roles, behaviours, activities, and attributes that a given society considers appropriate for boys and men or girls and women' (American Psychological Association, 2011, p. 1). However, as researchers have not yet been able to separate the effects of sex and gender on autism presentation, the term 'sex/gender' is used throughout this paper to acknowledge the overlap between the two (Lai, Lombardo, Auyeung, Chakrabarti, & Baron-Cohen 2015; Springer, Stellman, & Jordon-Young, 2012). In accordance with research suggesting there is no one preferred way of describing autism within the broader autism community, both person-first (e.g., individual with autism) and identity-first (e.g., autistic female) will be used within this paper (Kenny et al., 2016).Reliable physiological and/or genetic biomarkers are yet to be identified for autism (Goldani, Downs, Widjaja, Lawton, & Hendren, 2014). Consequently, diagnostic criteria are based predominantly on behavioural descriptors, such as difficulties with social-emotional reciprocity (APA, 2013). Current 'gold-standard' diagnostic instruments, such as the Autism Diagnostic Observation Schedule (ADOS, Lord, Rutter, DiLavore, & Risi, 2001) and Autism Diagnostic Interview-Revised (ADI-R, Rutter, Le Couteur, & Lord, 2003), have been developed predominantly using samples of males, meaning diagnostic criteria may be biased towards a male manifestation of the condition (Kirkovski, Enticott, & Fitzgerald, 2013; Kreiser & White, 2014). For example, the validation sample for the ADOS was made up of only 36 females with autism, compared with 170 males (Lord et al., 2000). Moreover, when used diagnostically, these instruments have been found to miss a disproportionate amount of females with autism. Lai et al., (2011) found that only 21% of adult females diagnosed with autism in childhood met ADOS cut-off scores, compared with 58% of males, despite having similarly low theory of mind scores. Consistently, Russell, Steer and Golding (2011) analysed a longitudinal UK cohort study and found that girls with similar levels of autistic traits to boys, were significantly less likely to receive an autism diagnosis than their male counterparts. Ratto et al. (2018) found that females with higher IQ were significantly less likely than males to meet criteria on the ADI-R. Finally, Dworzynski, Ronald, Bolton, and Happé (2012) found that girls, but not boys, who met diagnostic criteria showed higher levels of behavioural and/or cognitive difficulties than

neurotypical peers with similarly high levels of autistic traits. Overall, these findings suggest that females may be missed in the diagnostic process – unless presenting with comorbid behavioural or cognitive difficulties - and therefore provide evidence that the diagnostic criteria are biased towards a male-specific manifestation of autism. This may also partly account for why females are underdiagnosed, misdiagnosed, or diagnosed on average later than males (Dworzynski et al., 2012; Hull & Mandy, 2017).

1.1.2 Broad and Narrow Constructs in Autism

Sex/gender differences in autism may be particularly prevalent in the areas of social communication and interaction, which is one of the two core areas of difficulty from the DSM-5 Autism Spectrum Disorder diagnostic criteria (APA, 2013). Social interactions and communication difficulties are further broken down into three subdomains in the DSM-5: (1) deficits in social-emotional reciprocity, (2) deficits in nonverbal communicative behaviour used for social interaction, and (3) deficits in developing, maintaining, and understanding relationships; illustrative examples are given for each of these three subdomains in Table 1 (See Appendix A, for full diagnostic criteria). Social communication difficulties can be measured at either the level of 'broad' or 'narrow' construct (Lai et al., 2015). Broad constructs define autism abstractly, such as the DSM-5 criteria of deficits in social interaction and communication. In contrast, narrow constructs are fine-grained subdomains of the broad constructs, such as the three subdomains outlined above (e.g., difficulties in social-emotional reciprocity), associated psychological constructs (e.g., social attention), and co-occurring issues (e.g., social anxiety). Each narrow construct will have a range of associated behavioural exemplars, such as difficulties engaging in back-and-forth conversations, time spent interacting with peers, atypical eye gaze patterns (e.g., less likely to make eye contact, particularly in unfamiliar situations or with unfamiliar people), and specific types of anxiety symptoms. For the purpose of the current systematic review and meta-analysis, we focus on narrow constructs and behavioural exemplars of (the broad constructs) social communication and interaction, based upon DSM-5 criteria (Table 1).

Table 1: Examples of broad / narrow constructs and associated behavioural exemplars based upon DSM-5 diagnostic criteria

Broad Construct	Narrow Constructs	Behavioural Exemplars
Social interaction and communication difficulties	Social-emotional reciprocity	Back-and-forth of conversation
		Sharing of emotion
	Nonverbal communicative behaviour	Integration of verbal and non-verbal behaviours
		Eye contact
	Developing, maintaining, and understanding relationshipis	Adjustment of behaviour to suit context
		Sharing of imaginative play
		Peer engagement behaviour

Reviews investigating sex/gender differences in social interaction and communication at the level of broad construct have tended to find no differences between males and females. For example, in a meta-analysis, van Wijngaarden-Cremers et al. (2014) found no significant differences between autistic males and females in the core domains of social interaction and communication, both across the sample as a whole, and when split into five different age categories (toddlers, pre-schoolers, children, adolescents, and adults). In another meta-analysis, Hull, Mandy, and Petrides (2017a) also reported no significant differences between autistic males and females in terms of their social and communication difficulties. Two recent and relatively large-scale studies also found autistic males and females (ages ranged from 1 to 56 years) had very similar overall communication and social interaction difficulties, as measured by the ADOS and ADI-R (Mussey, Ginn, & Klinger, 2017; Ratto et al., 2018).

The aforementioned studies are based on studies employing pre-existing diagnostic instruments – predominantly the ADOS and ADI-R – and tend to report overall social interaction and communication scores which, therefore, are at the broad construct level. However, as outlined above, these instruments may be male-biased, because they have been developed mainly from samples of autistic males. Therefore, they may not be sensitive to the way in which autism manifests in females, particularly with respect to social interaction and communication variables (Hull & Mandy, 2017; Lai et al., 2015). To overcome these limitations, Lai et al. (2015) recommended that sex/gender differences in autism should be investigated by focusing on narrow constructs and behavioural exemplars of social communication and interaction, rather than comparing algorithm scores from pre-existing diagnostic instruments.

In contrast, studies which have measured social interaction and communication abilities using narrow constructs (not included in the aforementioned mentioned results) and associated behavioural exemplars have often found sex/gender differences. For example, relative to autistic males, autistic females have been found to demonstrate more sophisticated social behaviours, such as increased social reciprocity, interest sharing, verbal and non-verbal behavioural integration (i.e., gestural integration), imagination (i.e., engagement in imaginative play) and behavioural adjustment to suit the social context, despite having similarly low levels of social understanding as measured by social cognitive tasks (Hiller, Young, & Weber, 2014; Lai et al., 2015). Friendships may also be experienced differently, with autistic girls more likely to be overlooked by peers than autistic males, who are more likely to be rejected than females with autism (Dean et al.,

2014). In addition, girls with autism have been found to present more similarly to neurotypical peers in a number of areas, such as peer engagement on the playground (Dean, Harwood, & Kasari, 2017), social motivation (Head, McGillivray, & Stokes, 2014), social reciprocity (van Ommeren, Koot, Scheeren, & Begeer, 2017), and the use of pragmatic language markers (Parish-Morris et al., 2017). Consequently, autistic girls may appear superficially similar to neurotypical peers, perhaps through a process of 'camouflaging' their social difficulties, defined as the use of compensatory behaviours (e.g., standing in close proximity to peers so as to appear part of a group without fully participating) in order to mask social challenges (Dean et al., 2017). Although females with autism may appear superficially similar to neurotypical females, upon detailed observation and/or analysis of behaviour they still likely display social difficulties. For example, females in the Dean et al. (2017) study did not interact with other girls, despite standing close to them. Camouflaging may also contribute to the under-recognition of autism in diagnostic settings for females, discussed above (Loomes et al., 2017).

1.1.3 Current Study

To further understand the extent and nature of gender differences in narrow constructs of social communication, the current systematic review and meta-analysis investigated reported sex/gender differences. Specifically, data were collected from studies that included measures of narrow constructs - and associated behavioural exemplars – of social interaction and social communication, based on DSM-5 symptom subdomains, which have not been measured using diagnostic instruments (e.g., ADOS). This analysis builds upon existing research to address issues with diagnostic bias, as well as our understanding of the contradictory findings discussed above.

If the diagnostic profile of autistic males and females differ in terms of their social interaction and communication at the narrow construct/behavioural exemplar level, it suggests that diagnostic criteria need to reflect these differences and be altered accordingly. In addition, any adaptation also depends on whether sex/gender differences in autism reflect those found in neurotypical populations; if they do, then diagnostic criteria should account for this. For example, there may be a need for gender-specific cut-off scores depending on the particular area, or subset of skills, under investigation. Moreover, if there is a differential effect of gender on autistic and neurotypical individuals, it may suggest the need to develop gender-specific autism diagnostic criteria (Hull et al., 2017a). Following Hull et al. (2017a), only studies that reported on data for both male and female

autistic (or high levels of autistic traits) and neurotypical participant groups were included in this analysis to help disentangle the effects of gender in autism, in terms of social interaction and communication. This exploration of evidence also assists to further illuminate the 'camouflaging' phenomenon; if, for example, autistic girls appear more similar to neurotypical female peers than autistic males, this may help explain why they often are misdiagnosed, or diagnosed later than males.

1.1.4 Review Questions

This review aims to address the following two questions:

(1) What, if any, are the sex/gender differences in narrow construct subdomains of the DSM-5 autism diagnostic criteria of social and interaction and communication?

(2) Do any reported sex/gender differences vary between autistic and neurotypical groups (i.e., is there an interaction between sex/gender and diagnostic group)?

1.2 Method

1.2.1 Search Strategy

A search of the databases PsychINFO, Medline, Psych Articles, CINAHL (Plus with Full Text), and PubMed directories in January 2019 produced (1188) initial results (see Appendix B for search strategy). An additional seven papers were identified through other sources (reading through reference list of key papers). One author was contacted to ask for data for inclusion in the analysis, but did not respond to this request.

1.2.2 Inclusion and Exclusion Criteria

Eligibility criteria were quantitative cross-sectional peer-reviewed published articles, which included both neurotypical and autistic males and females, and a measure that incorporated a subdomain (narrow construct) of the DSM-5 autism diagnostic criteria of social interaction and communication. No language restrictions were applied. As we are aiming to shed light on the camouflaging hypothesis, studies were also included if they compared males and females with high and low autistic traits (as these individuals are likely to be camouflaging, as they have not yet received a diagnosis).

Studies were excluded if they did not include males and females with and without an autism diagnosis (or high levels of autistic traits), or only included a very small number of

autistic females (five or less). All studies that did not include a measure with a reported subdomain (narrow construct) of the DSM-5 autism diagnostic criteria of social interaction and communication were excluded, for example, global social interaction and communication scores, overall autistic traits scores, biological measures, and IQ or executive functioning scores. Outcomes based solely on pre-existing diagnostic instruments were excluded. Studies that did not employ a quantitative cross-sectional design were also excluded, such as qualitative, intervention, and single-case designs.

Table 2: Rationale for inclusion and exclusion criteria

Inclusion / exclusion criteria	Rationale
Only quantitative cross sectional studies were included	The review seeks to ascertain whether there are quantifiable differences between males and females with and without autism, at a given point in time.
Only peer reviewed studies were included	The time and resources involved in searching the grey literature were greater than were available. However, publication bias was assessed using funnel plots.
Only studies that included both autistic and neurotypical males and females were included	It is important to determine whether sex/gender differences found in autistic individuals are also found in neurotypical individuals. For example, this could influence any potential change in diagnostic criteria.
Only studies that included a subdomain (narrow construct) of the DSM-5 autism diagnostic criteria of social interaction and communication were included.	Previous sex/gender difference reviews and meta-analyses (e.g., Hull et al., 2017a) have predominantly been based on global measures of social interaction and communication. However, there is a growing body of research investigating sex/gender differences in narrow construct domains. To date, there has been no attempt to systematically review studies that have only incorporated narrow construct measures of social interaction and communication.
Studies were excluded if they only included a very small number of autistic females (five or less)	A sufficient number of participants in each group is needed to allow for statistical comparisons.
Studies were excluded if outcomes were based solely on pre-existing diagnostic instruments.	Current diagnostic instruments may not be sensitive to the autism female phenotype and therefore may not capture sex/gender differences.

The systematic review, including search terms and all relevant criteria, was prospectively registered on Prospero (registration number: CRD42019120804). A visual representation of the search methodology is shown in Figure 1. A total of 14 studies met inclusion criteria.

1.2.3 Quality Appraisal Tool

The quality of included studies was appraised using the Appraisal Tool for Cross-Sectional Studies (AXIS, Appendix C). This tool was chosen because it was designed specifically for cross-sectional studies, which is one of the inclusion criteria of this review. Due to a lack of appraisal tool for cross-sectional studies, the AXIS was developed through an international Delphi panel of 18 medical and veterinary experts (Downes, Brennan, Williams, & Dean, 2016). The AXIS tool consists of 20 questions, which require an answer of 'yes', 'no', or 'do not know'. These questions relate to the introduction ('were the aims/objectives of the study clear?'), methods (e.g., 'was the sample size justified?'), results (e.g., 'were the basic data adequately described?'), discussion (e.g., 'were the limitations of the study discussed'), or other aspects (e.g., 'were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?') of studies.

Scores for studies in the current review ranged from 12-19 out of 20 (M = 13.57, SD = 1.65). The AXIS does not provide a numerical scale for judging the quality of studies, and therefore a degree of subjective judgement was needed. It was decided that all studies met the basic quality needed for inclusion in the review. This is because all studies had clear aims and objectives, an appropriate design, adequately described basic data, had discussions and conclusions which were justified by the results, and gained consent from participants. Although the studies had drawbacks, such as the fact that none justified their sample size (e.g., through a power analysis) and the majority (13 out of 14) of studies did not report response rate, all studies were considered to be of adequate quality (Appendix D for full AXIS scores). It was not possible to conduct a sensitivity analysis, as only one study was deemed to be high quality (Harrop et al. 2018), and all other studies were deemed to be of very similar quality, reflected in their similar scores (nine studies scored 13, three scored 14, and one scored 12).

Tables 3 and 4 present information describing all 14 studies, including characteristics of the sample employed and key findings. To minimise bias, a second researcher independently completed each stage of the process for a proportion of studies (25-50%) to check for consistency. Discrepancies were resolved through discussion until a consensus was reached. There were five or fewer discrepancies at each stage.

Figure 1: PRISMA flow diagram of study identification and selection

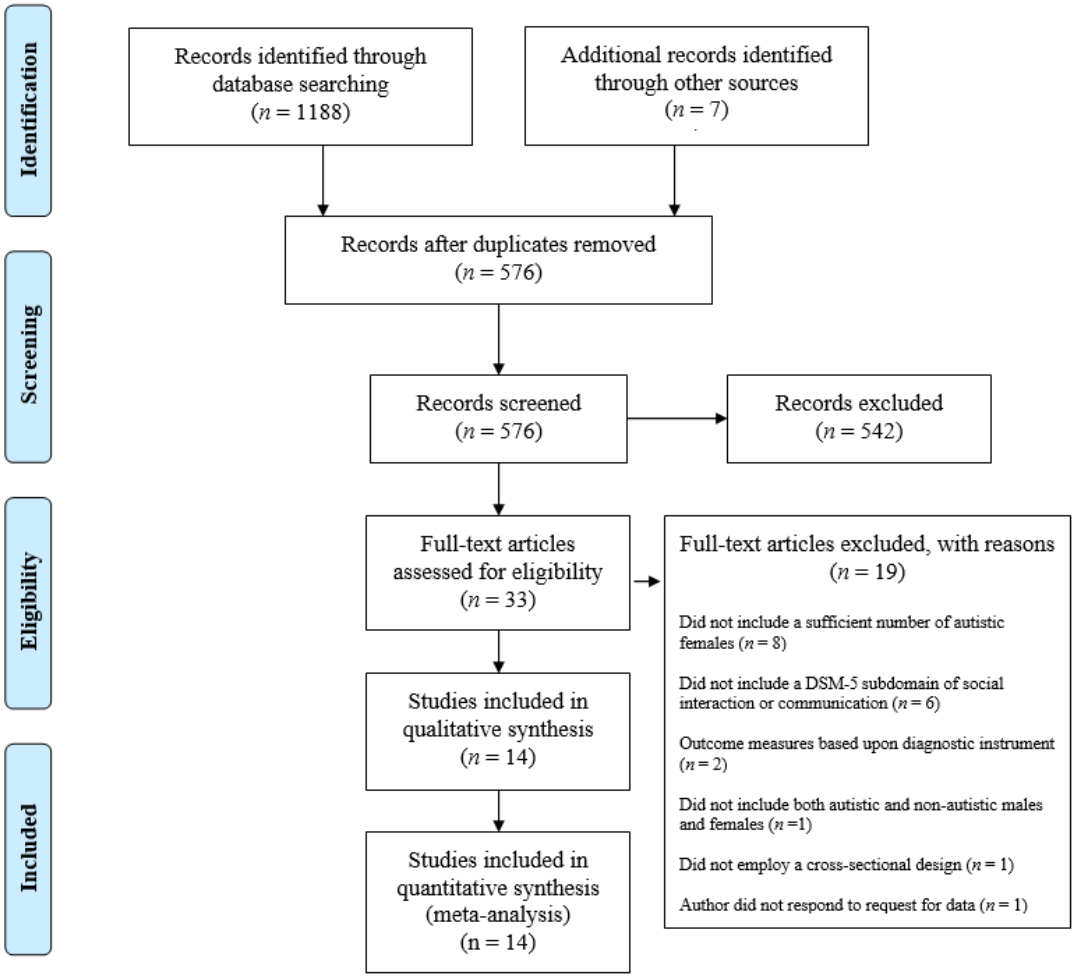


Table 3: Sample characteristics of studies included in the review

	Authors (date)	Behavioural Exexmplar assessed	ASC group diagnoses at the time of study	ASC diagnostic criteria used	How diagnosis confirmed	ASC			Neurotypical		
						Males (*n*)	Females (*n*)	Mean age (years)	Males (*n*)	Females (*n*)	Mean age (years)
1	Baron-Cohen and Wheelwright (2003)	Social motivation	AS/HFA (proportions not reported)	DSM-IV criteria for autism/AS	Not reported	51	17	34.4	27	49	40.5
2	Charwarska et al. (2016)	Social attention	Siblings of children with ASD (100%)	N/A	ADOS	71	30	0.75	32	29	0.75
3	Cheng et al. (2017)	Interpersonal motor synchrony	N/A	N/A	AQ	19	19	29.1	28	17	32
4	Dean et al. (2014)	Peer relationships	ASD (100%)	Not reported	Clinician assessment and ADOS	25	25	7.5	25	25	7.8
5	Dean et al. (2017)	Peer engagement behaviours	ASD (100%)	Not reported	ADOS	24	24	7.7	24	24	7.9
6	Harrop et al. (2018)	Social attention	ASD (100%)	Not reported	SCQ and mixture of clinician assessment, ADOS, ADI-R, and CARS	23	22	9.0	16	16	7.8
7	Harrop et al. (2017)	Play behaviours	ASD (100%)	Not reported	ADI-R/ADOS	14	14	3.8	14	12	2
8	Head et al. (2014)	Social motivation	ASD (not including LFA or PDD-NOS; 100%)	Not reported	Not reported	25	25	13.7	26	25	12
9	Horiuchi et al. (2014)	Peer difficulties	ASD (100%)	DSM-IV-TR criteria for ASD	Clinician assessment	124	44	7.9	124	44	7.92
10	Knickmeyer et al. (2007)	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	Not reported	46	20	10.2	31	24	5.2
11	Parish-Morris et al., (2017)	Social pragmatic hesitation markers	ASD (100%)	DSM-IV-TR criteria for ASC	Clinician assessment and ADOS and ADI-R	49	16	9.9	8	9	11.3
12	Sedgewick et al. (2016)	Peer relationships	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
13	Sedgewick et al. (2018)	Peer relationships	ASD (100%)	DSM-IV-TR or DSM-5 or ICD-10 criteria for autism/AS/ASD	Clinician assessment and ADOS and SRS	26	27	14.4	23	26	14.4
14	van Ommeren et al. (2017)	Social reciprocity	AD (22%), AS (8%), PDD-NOS (56%) MCDD (14%)	DSM-IV-TR criteria for ASD	Clinician assessment and SRS	114	32	13.8	55	24	11.4

Note : Charwarska et al. (2016) collected data from the same participants at 6, 9, and 12 months of age (we report the average from the three time points); data from Cheng et al. (2017) is based upon pairs of males and females who have high or low autistic traits; ASC: autism spectrum condition; AS: Asperger's syndrome; ASD: autism spectrum disorder; HFA: high functioning autism; PDD-NOS: pervasive developmental disorder, not otherwise specified; AD: autistic disorder; MCDD: multiple complex developmental disorder; DSM-IV: Diagnostic and Statistical Manual of Mental Disorders (4th ed.); DSM-IV-TR: Diagnostic and Statistical Manual of Mental Disorders (4th ed., text rev.); ICD-10: International Classification of Diseases (10th ed.); DSM-5: Diagnostic and Statistical Manual of Mental Disorder (5th ed.); ADOS: Autism Diagnostic Observation Schedule; AQ; Autism-Spectrum Quotient Questionnaire; SCQ: Social Communication Questionnaire; ADI-R: Autism-Diagnostic Interview-Revised; CARS: Childhood Autism Rating Scale; SRS: Social Responsiveness Scale.

Table 4: Measures and key findings from included studies

Article	Authors (date)	Outcome measures	Key findings
1	Baron-Cohen and Wheelwright (2003)	FQ	The group by gender interaction interaction approached significance (F(df = 1, 139) = 3.5, p = .06), resulting from a very small differences between males and females in the AS/HFA groups, but a significant difference between TD males and females (with TD females scoring more highly)
2	Charwarska et al. (2016)	Proportion of time looking at scene as a whole; proportion of time spent looking at another persons face.	Scene: Significant gender by risk status interaction F(1, 153) = 5.42, p = .021) on proportion of time looking at scene as a whole. High risk (HR) females had higher proportions than HR males (p = .003, d = .60) and low risk (LR) females (p = .026, d = .39). HR and LR males did not differ (p = .999), nor did LR females and LR males (p = 1.00). Face: HR females exhibited greater attention to the speaker's face than HR males (p = .048, d = .44) and marginally higher face attention than LR females (p = .057, d = .48). HR and LR males did not differ (p = .992), nor did LR females and males (p = .932).
3	Cheng et al. (2017)	Step synchrony	The main effect of group, F(2, 138) = 4.977, p = .008, $\eta 2$ = .067 was significant, as was gender, F(1, 138) = 20.44, p < .001. $\eta 2$ = .129. pairs with low autistic traits synced better than pairs with high autistic traits. The interaction between gender and group was not significant, p = .253.

4	Dean et al. (2014)	FS	Social preferences: ASD females (*M* = 3.64) and ASD males (*M* = 3.48) had similiar scores and the interaction between gender and diagnosis was non-signifcant, *F*(df = 1, 96) = 1.09, *p* = .30, ω2 = 0.2); Social acceptance: ASD females (*M* = 1.76) and males (*M* = 1.76) had similiar scores and the interaction between gender and diagnosis was non-significant, *F*(4, 95) = 0.41, *p* = .53, *ω2* = 1.35); Social connections: ASD females (*M* = 2.72) had more social connections than ASD males (*M* = 1.68), which represented a small-to-medium effect (*d* = 0.44) and the interaction between gender and diagnosis was non significant, *F*(3, 96) = 1.35, *p* = .25, *ω2* = 0.01); Interactions between reciprocal friendship (statistical results not reported), and rejection (statistical results not reported) were also non significant.
5	Dean et al. (2017)	POPE	Game: The interaction effect on Games indicated that TD boys *F*(3, 92) = 5.18, *p* = .025, *ω2* = 0.053) spent significantly more time playing games than all other groups; Joint engage: girls with and without ASD spent more time in Joint Engage than boys with and without ASD (*F*(3, 92) = 7.76, *p* = .006, *ω2* = 0.078). Diagnosis and the interaction were not significant. For solitary, there was a significant diagnosis be gender interaction, ASD boys spent significantly more time in solitary than all other groups (*F*(3, 92) = 4.37, *p* = 0.03, *ω2* = 0.05).
6	Harrop et al. (2018)	Preference to faces; prioritisation of faces	Preference: There was a significant condition by gender interaction in both the whole sample, *F* = 12.18, *p* < 0.01, *η2* = 0.15, and ASD group, *F* = 7.60, *p* = 0.01, *η2* = 0.16. These indicated that females (in the whole sample and ASD group) fixated longer than males to faces when paired with circumscribed-related images. Prioritisation: Main effect of sex *F* = 4.50, *p* = .04, *η*2 = 0.06, with females being faster to attend to faces than males. Trend for ASD group to be slower to orient to faces than TD group *F* = 3.14, *p* = .08, *η2* = 0.04.Trend for ASD males to be slower than females to attend to faces *F* = 2.47, *p* = .09, *η2* = 0.06.

7	Harrop et al. (2017)	Play complexity; toy engagement	For play complexity, no significant main effect of gender or diagnosis by gender interaction for any of the four conditions. For toy engagement, significant gender by diagnosis interaction for engagement with toys and garages, $F(3, 50) = 6.21$, $p = 0.01$, $\eta 2 = 0.11$. TD boys > ASD girls ($p < .01$), TD girls ($p < .01$), ASD boys ($p = .04$). No significant interactions for any other conditions. Significant main effect of gender for engagement with dolls, $F(3, 50) = 13.54$, $p < 0.01$, $\eta 2 = 0.21$ and domestic toys, $F(3, 50) = 10.24$, $p < 0.01$, $\eta 2 = 0.17$. No significant differences in either play complexity or toy engagement between preschool-aged girls and boys with ASD
8	Head et al. (2014)	FQS	Females with ASD scored signifiacntly higher than males with ASD, $t(48) = -3.64$, $p < .05$). Females with ASD had very similiar score to males with ASD, $t(100) = -2.36$, $p > 0.05$. Females with ASC were also more similar to TD males than females with ASC to TD females. However, no significant interaction between sex and diagnosis, $F(1, 101) = 1.00$, $p > 0.05$, $\eta 2 = 0.01$); ASC females > ASC males $t(48) = -3.64$, $p < 0.05$).
9	Horiuchi et al. (2014)	Peer problems and proscial behaviour subscales of SDQ	Non-significant difference between males and females with ASD on peer problems ($p = .612$) and prosocial behaviour ($p = .862$) subscale. Non-signifiacnt difference between TD males and females for prosocial behaviour ($p = .346$). There was a significant trend for TD males to have greater peer problems than TD females ($p = .068$). However, when data was split into different ages, autistic females aged 13-16 years had greater peer problems ($M = 6.80$) than same aged autistic boys ($M = 5.50$), which represented a medium-to-large effect ($d = 0.62$). Similar levels of peer problems where found in TD females ($M = 1.80$) and TD males ($M = 1.50$), which represented a small effect ($d = 0.19$).

10	Knickmeyer et al. (2007)	CPQ	Girls with an ASC had higher scores on games involving pretence than boys with an ASC, t(64) = 4.06, p < .001. Girls with ASC showed a significant preference for female-typical pretence items, in comparison to male-typical pretence items, t(19) = -4.96, p < .001. TD girls and boys had similar scores for pretence overall (statistics not reported). TD girls (d = 3.3) and boys (d = 2.2) both showed a significant preference for pretence items typical of their gender. ASD boys only showed a small preference for male-typical pretence items (d = 0.3). CPQ: sex-typical play shown by TD females, $t(42) = 11.58$, $p < .001$), TD males $t(60) = 13.55$, $p < .001$, and ASC males $t(45) = 11.8$, $p < .001$); sex-typical play not shown by ASC females $t(19) = -1.30$, $p = .21$).
11	Parish-Morris et al., (2017)	UM use; UH use; and UM ratio (total amount of UMs relative to total amount of filled pauses)	Average UM use did not differ in autistic boys (mean = 0.0143, SD = 0.0156) as compared to autistic girls (0.0161), $Z = -1.19$, $p = .24$; Boys with ASD produced more UH relative to total words produced (0.0084) than girls with ASD (0.0044), $Z = -1.98$, $p = .02$, $r = 0.29$. There was also a significant sex difference in UM ratio ($Z = -2.16$, $p = .03$, $r = 0.26$), reflecting higher UM ratio for autistic girls (75%) than boys (56%). TD boys produced significantly more UH (0.0083) than TD girls (0.0032), $Z = -2.32$, $p = .02$, $r = 0.56$). UM production was similar between TD boys (0.0301) and TD girls (0.0234), $Z = -1.06$, $p = .29$, $r = 0.26$). UM ratios were similarly high for both TD girls (85%) and boys (78%), $Z = -0.87$, $p = .39$, $r = 0.21$. Girls with ASD and typical girls used comparable levels of UM ($p = .34$) and UH ($p = .61$), and had similar UM ratios ($p = .16$). Boys with ASD produced significantly less UM than typical boys ($p = .002$), and typical boys produced higher UM ratios than boys with ASD ($p = .06$). Boys in the ASD and TD groups did not differ on average UH ($p = 0.63$).

12	Sedgewick et al. (2016)	FQS	SRS-2: Significant interaction between gender and diagnosis, $F(1, 42) = 7.45$, $p = .009$, $\eta 2 = .15$. ASC male > ASC female $t(21) = 0.242$, $p = 0.03$, $d = 1.03$); no significant difference between TD male and TD female $t(21) = 1.68$, $p = .11$. FQS: Significant interaction between sex and diagnosis for help $F(1, 42) = 6.21$, $p = 0.01$, $\eta 2 = 0.13$) and closeness $F(1, 42) = 6.26$, $p = .01$, $\eta 2 = 0.13$ subscales; no significant interactions for all other subscales; for security subscale, ASD girls > ASD boys.
13	Sedgewick et al. (2018)	FQS and RPEQ	FQS: No significant interactions for total score and all subscales. For strength, TD and ASD girls > TD and ASD boys $F(1, 98) = 4.76$, $p = .03$, $\eta 2 = 0.04$; for closeness, TD and ASD girls > TD and ASD boys; for security TD and ASD girls > TD and ASD boys; for helpfulness, TD and ASD girls > TD and ASD boys (test statistics not reported). RPEQ: For total conflict, significant diagnosis by gender interaction, $F(1, 98) = 5.33$, $p = .02$, $\eta 2 = 0.05$. ASD females > TD girls, $t(51) = 3.65$, $p = .001$), ASD boys ($p < .05$), TD boys ($p < .05$); for victimhood subscale, significant diagnosis by gender interaction $F(1, 98) = 9.35$, $p = .003$, $\eta 2 = 0.08$. ASD girls > TD girls, TD boys, ASD boys ($ps < .05$); for relational aggressor subscale, ASD and TD boys > ASD and TD girls $F(1, 98) = 6.63$, $p = .01$, $\eta 2 = 0.05$; for total overt conflict subscale, ASD and TD boys > ASD and TD girls, $F(1, 98) = 7.60$, $p > 0.01$, $\eta 2 = 0.03$; for total relational conflict, significant diagnosis by gender interaction, $F(1, 98) = 6.21$, $p = 0.01$, $\eta 2 = 0.06$. ASD girls > TD girls, ASD boys, ASD girls ($ps < .03$); for relational victimhood, significant diagnosis by gender interaction, $F(1, 98) = 8.42$, $p = .005$, $\eta 2 = 0.07$. ASD girls > TD girls, ASD boys, ASD girls ($ps < .01$).
14	van Ommeren et al. (2017)	IDT	ASD Girls had significantly higher total IDT scores than ASD boys, $F(1, 132) = 6.46$, $p = .01$, $\eta 2 = 0.05$, primarily due to higher scores for reciprocal interaction in the other's initiative, $F(1, 133) = 6.74$, $p = 0.01$, $\eta 2 = 0.05$.Girls and boys with ASD scored similarly on the scales of turn-taking, $F(1, 132) = 2.35$, $p = 0.13$, reciprocal interaction, $F(1, 133) = 3.02$, $p = .08$, and reciprocal flexibility, $F(1, 133) = 5.07$, $p = .02$, $\eta 2 = 0.04$ (non-significant after Bonferroni correction). ASD girls <

	TD girls for total IDT scores, $F(1, 49) = 8.49$, $p = .005$, $\eta 2 = 0.15$, turn-taking, $F(1, 49) = 7.90$, $p = .007$, $\eta 2 = 0.14$, and reciprocal interaction in the other initiative, $F(1, 53) = 13.01$, $p = .001$, $\eta 2 = 0.20$.ASD boys < TD boys total IDT scores, $F(1, 160) = 49.29$, $p < .001$, $\eta 2 = 0.24$. They scored lower on turn-taking, $F(1, 160) = 25.97$, $p < .001$, $\eta 2 = 0.14$, reciprocal interaction in the other's initiative, $F(1, 166) = 96.10$, $p < .001$, $\eta 2 = 0.37$, and reciprocal flexibility, $F(1, 166) = 26.21$, $p < .001$, $\eta 2 = 0.14$

FQ: Friendship Questionnaire; FS: Friendship Survey; POPE: Playground Observation of Peer Engagement; CPQ: Child Play Questionnaire; FQS: Friendships Qualities Scale; SDQ: Strengths and Difficulties Questionnaire; RPEQ: Revised Peer Experiences Questionnaire; IDT: Interactive Drawing Test; TD: Typically Developing; ASD: Autism Spectrum Disorder

1.3 Qualitative Review

The following section provides a qualitative synthesis of the results from the 14 studies included in the review. These have been split into narrow constructs and behavioural exemplars, which correspond to one of the three DSM-5 symptom subdomains (Table 5).

Table 5: Number of papers reviewed for each DSM-5 symptom subdomain and corresponding narrow constructs / behavioural exemplar

DSM-5 symptom subdomain	Number of papers reviewed for DSM-5 symptom subdomain	Narrow construct / behavioural exemplar	Number of papers reviewed for narrow construct / behavioural exemplar
Developing, maintaining, and understanding relationships	9	Peer relationships	3
		Peer engagment behaviour	1
		Peer difficulties	1
		Social motivation	2
		Play behaviours	2
Nonverbal communicative behaviour	3	Social attention	2
		Pragmatic language	1
Social-emotional reciprocity	2	Social reciprocity	1
		Interpersonal motor synchrony	1

1.3.1 Developing, Maintaining and Understanding Relationships

1.3.1.1 Peer relationships.

Dean et al. (2014) analysed peer nomination data for girls with and without autism (n = 50) and boys with and without autism (n = 50), aged 6-10 years. They found no significant differences between autistic girls and boys in terms of their social preferences (i.e., the number of classmates they nominated as friends) and social acceptance (i.e., the number of classmates that listed them as a friend). However, girls with autism had more social connections (i.e., the amount of classmates that they played with, nominated by themselves and others) than males with autism (d = 0.44). Boys with and without autism were more frequently nominated as someone that classmates did not like to play with (i.e., the rejection category) than girls with and without autism. There were no significant interactions between gender and diagnosis for social preferences, social acceptance, or social connections. These findings suggest that girls with autism were different to boys with autism in some domains of friendships (social connections and rejection by peers), but similar in others (social preferences and social acceptance). It is noteworthy that girls with autism in this study had significantly higher overall social communication difficulties than boys with autism (as measured by the ADOS), which may have served to minimise the between-gender differences found.

Sedgewick et al. (2016) examined the friendship experiences of 46 adolescents (10 boys with autism, 13 girls with autism, 10 neurotypical boys, 13 neurotypical girls) aged 12-16 years. It was found that adolescent boys with autism had significantly lower ratings of helpfulness (e.g., believing a friend would help them if needed) and closeness (e.g., missing a friend if they were to move away) than all other groups; there were no significant differences between adolescent girls with autism and neurotypical boys and girls. Boys with and without autism had significantly lower scores for security (i.e., believing their friendships to be secure) than girls with and without autism. Girls and boys with autism reported significantly lower scores for conflict items (reflecting a perceived lack of conflict in their friendships than non-autistic adolescents), and there was no significant main effect of gender or interaction. These results suggest that adolescent girls with autism reported the quality of their friendships to be similar to girls without autism, and different to adolescent boys with autism on a number of domains (besides conflict).

In a further study of friendship quality, Sedgewick et al. (2018) examined the friendship and conflict experiences of 102 adolescents (26 boys with autism, 27 girls with autism, 10 neurotypical boys, 26 neurotypical girls and 23 neurotypical boys), aged 11-18 years. They found that autistic adolescent girls perceived themselves as having greater closeness, security, helpfulness, and strength than neurotypical and autistic adolescent boys. Adolescent girls and boys with autism reported significantly more conflict in their friendships than non-autistic adolescent girls and boys. In addition, girls with autism reported significantly higher victimhood, total relational conflict, and relational victimhood than boys with autism and neurotypical girls and boys. Neurotypical and autistic boys reported being more overtly aggressive, and experiencing more overt conflict, than neurotypical and autistic girls. Again, these results suggest that the friendships of girls with autism are more similar to neurotypical girls, than they are to boys with or without autism.

1.3.1.2 Peer engagement behaviour.

Dean et al. (2017) examined the social behaviours of 96 7-year old children (24 boys with autism, 24 girls with autism, 24 neurotypical boys, 24 neurotypical girls) on the playground, and coded whether children were playing games, socialising with peers, or by themesleves. They found that girls and boys with autism spent similar amounts of times playing games with peers. The interaction effect indicated that neurotypical boys spent significantly more time playing games than all the other three groups. Girls with and without autism spent significantly more time socialising with peers than boys with and without autism. The interaction between gender and diagnosis was not significant. Boys

with autism spent significantly more time alone and/or not engaging with other children than all the three other groups. These results suggest that girls with autism appeared similar to neurotypical girls without autism. In contrast, boys with autism appeared different to neurotypical boys such that they were less likely to play games than their male peers.

1.3.1.3 Peer difficulties.

Horiuchi et al. (2014) analysed data for 346 children (129 boys with autism, 44 girls with autism, 129 neurotypical boys, 44 neurotypical girls) with an average age of 7 years (ages ranged from 4-16 years). No significant differences between males and females with autism in terms of peer problems were found. However, when data were split into different ages, autistic females aged 13-16 years had more peer problems than same-aged autistic boys, which represented a medium-to-large effect (d = 0.62). In contrast, neurotypical males and females aged 13-16 years had similar levels of peer problems (d = 0.19). Autistic males and female had significantly greater peer problems than neurotypical males and females in every age group. These results suggest that peer problems are a key area of difficulty for males and females with autism, and that adolescence may be a period of particular difficulty for females with autism, illustrating the need for future research to consider developmental trajectories

1.3.1.4 Social motivation.

Social motivation can be defined as 'a set of psychological dispositions and biological mechanisms biasing the individual to preferentially orient to the social world, to seek and take pleasure in social interactions, and to work to foster and maintain social bonds' (Chevallier, Kohls, Troiani, Brodkin & Schultz, 2012, p. 232). In their study investigating the Friendship Questionnaire, Baron-Cohen and Wheelwright (2003) found that male (n = 51) and female (n = 17) adults with autism had similar levels of social motivation overall – which was significantly lower than neurotypical adult males (n = 27) and females (n = 49) – whereas neurotypical females had significantly higher social motivation than neurotypical males. In contrast, Head et al. (2014) found that females with and without autism had significantly higher social motivation than autistic and neurotypical males. There was no significant interaction between gender and diagnosis. However, females with autism had more similar levels of social motivation to neurotypical peers than males with autism. One possible reason for these discrepant findings is that participants in Baron-Cohen and Wheelwright (2003) were aged between 14 and 64 years.

In contrast, Head et al. (2014) included particpants from a narrower age range (10-16 years).

1.3.1.5 Play behaviours.

Harrop, Green, and Hudry (2017) examined the play complexity (e.g., simple object; presymbolic) and toy engagement (i.e., amount of time children spent engaged with toys) of 54 children (14 boys with autism, 14 girls with autism, 14 neurotypical boys, 12 neurotypical girls) aged 2-5 years. No main effect of gender was found for play complexity nor any significant interaction between gender and diagnosis. There were significant main effects of gender for toy engagement, in which girls played with domestic toys and dolls significantly more than boys overall. There was a significant interaction between gender and diagnosis for engagement with garages and cars, which demonstrated that neurotypical boys spent significantly more time playing with these toys than neurotypical girls, and boys and girls with autism. There were no other significant interactions. These findings suggest that girls and boys with autism have similar play complexity and differences in toy engagement generally reflect those found in typically developing populations. However, boys with autism may play with garages and cars less than neurotypical boys, which could lead to their play being perceived as less typical than girls with autism.

In contrast to the above findings, Knickmeyer, Wheelwright, and Baron-(2007) investigated the gender-typical play of 121 children (46 boys with autism, 20 girls with autism, 31 neurotypical boys, 24 neurotypical girls) aged 4-14 years. They found that girls with autism demonstrated significantly less gender-typical non-pretend play relative to neurotypical peers than boys with autism. A possible explanation for the discrepancy with Harrop et al. (2017), is that children in the Knickmeyer et al. (2007) study were on average older, and spanned a wider range of ages. In addition, Knickmeyer et al. (2007) also found that girls with autism engaged in significantly more pretend play than boys with autism - driven by a preference for gender-typical pretend play – which was akin to neurotypical boys and girls.

1.3.1.6 Summary of developing, maintaining, and understanding relationships.

In summary, the above results suggest that girls with autism differ from boys with autism in various different areas of their social relationships, such as having more social connections, being rejected less often, spending more time interacting with peers (rather than being alone), and having more friendship difficulties in adolescence, but having

greater closeness, security, helpfulness, and strength in these relationships. These differences tended to result in girls with autism being more similar to neurotypical girls, which may make their underlying social difficulties more difficult to detect. However, girls and boys with autism did appear similar in some aspects of friendship, such as their social preference levels and social acceptance. Results were mixed for both social motivation and play behaviours, which may reflect developmental differences, which highlights the need for future research to consider age as a potential moderating variable.

1.3.2 Nonverbal Communicative Behaviour

1.3.2.1 Social attention.

Salley and Colombo (2016, p.1) note that social attention can be used as a 'synonym for nonverbal social communication behaviors (i.e., joint attention behaviors including eye contact and gestures used for the purpose of coordinated social attention sharing with others)'. In a study of early social communication skills, Charwarska, Macari, Powell, DiNicola, and Shic (2016) analysed data taken from males and females at high risk of developing autism (i.e., younger siblings of children with autism), as well as low risk counterparts, collected when the participants were 6, 9, and 12 months of age. Overall, high-risk females exhibited significantly greater attention to a speakers face than high-risk males, whereas low risk- males and females did not differ in their attention levels to a speakers face. Harrop et al. (2018) found that females - both with and without autism (average group ages = 8.6 and 7.9 years respectively) - fixated significantly longer than males with and without autism (average group ages 9.5 and 7.8 years respectively) to images of faces when paired with circumscribed interest related images (e.g., trains, vehicles, and clocks); females (with and without autism) were significantly faster to attend to faces than males (with and without autism); and there was a trend for males with autism to be slower than females with autism to attend to faces. These results suggest that social attention in females with autism may be more similar to neurotypical individuals, when compared to males with autism. This may mitigate the development of social interaction and communication difficulties in females with, or at risk of developing, autism. However, replication, employing longitudinal designs is required to test this hypothesis.

1.3.2.2 Pragmatic language.

Pragmatic language can be defined as 'the use of language as a tool for communication; specifically, how language is used in the context of social interactions',

which includes turn-taking, adapting speech to suit the context, and body language (Eigsti, de Marchena, Schuh, & Kelley, 2011, p. 683). One such meaure of pragmatic language is conversation fillers, including words such as ‘um’ and ‘uh’ which may signal upcoming pauses to the listener (Clark & Fox Tree, 2002). Specifically, in a study of um and uh conversation fillers, Parish-Morris et al., (2017) found that girls with autism (average age = 10.7 years) had significantly higher um ratios (amount of ums produced, relative to overall um and uh use) than boys with autism (average age = 9.7 years), which was driven by suppressed uh production. In contrast, neurotypical boys and girls (average age of neurotypical group as a whole = 11.3 years) had similar um ratios. Girls with and without autism produced comparable levels of ums and uhs, and had similar um ratios. However, boys with autism produced significantly less ums than neurotypical boys, and had significantly lower um ratios. These results suggest girls with autism may sound similar to neurotypical peers, at least with respect to the conversation fillers of ums and uhs, whereas boys with autism may sound more atypical.

1.3.3 Social-Emotional Reciprocity

1.3.3.1 Social reciprocity.

Reciprocal behaviour can be defined as ‘a dynamic process of often spontaneous interacting and sharing of two or more people with equal, similar or complementary exchanges. This process of interacting includes finely timed and mutually attuned turn-taking and steadily increasing dynamics as the interaction unfolds’ (van Ommeren, 2018, pp. 16-17). van Ommeren et al. (2017) examined the reciprocal behaviour of 225 children (114 boys with autism, 32 girls with autism, 24 neurotypical girls and 55 neurotypical boys) and found that girls with autism had significantly higher total reciprocity scores than boys with autism. In contrast, neurotypical boys and girls had similar total reciprocity scores. Although both autistic girls and boys had significantly lower reciprocity scores than neurotypical girls and boys, the difference was smaller for girls (driven by higher reciprocity scores for autistic girls than boys). These results suggest that autistic females may have greater social reciprocity than autistic males. However, this conclusion is based on a single study, and therefore future replications are needed to substantiate this conclusion

1.3.3.2 Interpersonal motor synchrony.

Interpersonal motor synchrony (IMS) can be defined as movements of the body during social interaction that become synchronised over time, both spontaneously and intentionally (Fitzpatrick et al. 2016). In this sense, IMS can be conceptualised as a basic form of social reciprocity, as it requires an individual to adapt their behaviour in order to match that of another. Cheng, Kato, and Tseng (2017) found that, overall, pairs of individuals with high levels of autistic traits (19 females, 19 males) were significantly less synchronised than pairs of individuals with low autistic traits (17 females, 28 males). Females, irrespective of levels of autistic traits, were significantly more synchronised than males. The interaction between gender and autistic traits was not significant. These results suggest that, in terms of IMS, females with high autistic traits had greater IMS than males, which reflects gender differences found in the general population. This again suggests that females with autism may have greater reciprocity than males with autism, which may need to taken into account during the diagnostic process.

1.3.4 Summary of Qualitative Review

There is preliminary evidence that there are notable differences between males and females with autism in various subdomains of social interaction and communication, such as areas of peer relationships, social reciprocity, social attention, and pragmatic language. In general, these differences tend to make girls with autism appear more similar to neurotypical peers than boys with autism, which, when considering the male-biased diagnostic criteria, may contribute to the under-recognition of girls with autism. However, girls and boys with autism also appear similar in some areas of peer relationships, which may reflect the extremely broad nature of peer relationships. In addition, findings were mixed for play behaviours and social motivation, which may reflect developmental differences. Accordingly, more research is needed to definitively ascertain the nature of sex/gender differences in narrow construct measures of social interaction and communication, which may require the construction of new instruments (Lai et al. 2015).

1.4 Meta-Analysis

1.4.1 Statistical Analyses

Random effects meta-analyses were performed using Review Manager 5.3 (The Cochrane Collaboration, 2014) for narrow construct measures of social interaction and communication. Building upon the qualitative review, we tested the following two hypotheses (which are more specific versions of our original two review questions):

(1) Females with autism will have significantly better social interaction and communication than males with autism, which will be reflective of sex/gender differences in neurotypical populations.
(2) The difference between females with and without autism will be smaller than the difference between males with and without autism.

Standardised mean differences (*SMD*) were calculated for the following comparisons: (1) males and females with autism (2) neurotypical males and females (3) males with autism and neurotypical males (4) females with autism and neurotypical females. Although a wide range of outcomes measures were included in the analysis, these all represent subdomains of social interaction and communication difficulties as defined by the DSM-5, allowing meaningful interpretations to be drawn (e.g., in terms of diagnostic bias against females), which therefore suggests meta-analysis was appropriate (Borenstein, Hedges, Higgins, & Rothstein, 2009). Where multiple measures were used in one study, average means and pooled standard deviation were combined when the measures reflected one construct (e.g., different scales from the same questionnaire or observational measure). Alternatively, the measures most central to autism-related social communication/interaction difficulties and similar to other studies were included (Table 6).

Table 6: Measure used and age of participants for studies included in meta-analysis

Article	Measure used	Age of participants
Baron-Cohen & Wheelwright (2003)	FQ	Adults
Charwarska et al. (2016)	Mean proportion of time spent looking at faces averaged from 6, 9, and 12 months	Children
Cheng et al. (2017)	Mean PTSR	Adults
Dean et al. (2014)	Mean of social preferences, acceptance, and connections of FS	Children
Dean et al. (2017)	Mean of Games, Joint engage, and Solitary scores of POPE	Children
Harrop et al. (2018)	Average preference to face (with and without CI object)	Children
Harrop et al. (2017)	Average of play complexity and toy engagement	Children
Head et al. (2014)	Average FQ scores	Children and/or adolescents
Horiuchi et al. (2014)	Total peer problems score of SDQ	Children and/or adolescents
Knickmeyer et al. (2007)	Average of all play scores	Children and/or adolescents
Parish-Morris et al. (2017)	UM ratio	Children and/or adolescents
Sedgewick et al. (2016)	Average FQS scores	Children and/or adolescents
Sedgewick et al. (2018)	Average FQS scores	Children and/or adolescents
van Ommeren et al. (2017)	Total IDT scores	Children and/or adolescents

FQ: Friendship Questionnaire; PTSR: phase synchronization time ratio; FS: Friendship Survey; POPE: Playground Observation of Peer Engagement (solitary scores reversed); FS: Friendship Survey; FQS: Friendships Qualities Scale (conflict scores reversed); SDQ: Strengths and Difficulties Questionnaire (peer problem scores reversed); UM ratio: UM/(UM + UH)
IDT: Interactive Drawing Test

1.4.2 Publication Bias and Heterogeneity Assessment

Research suggests that studies with statistically significant results are more likely to be published (Dickersin & Min, 2003) – which could therefore bias the results in systematic reviews and meta-analyses – known as publication bias (Borenstein et al., 2009). The current review only included studies that have been published in a peer-reviewed journal, which make it susceptible to publication bias. Accordingly, evidence of publication bias was assessed using funnel plots, which plotted the effect size (*SMD*) from individual studies on the *X* axis and *SEM* on the *Y* axis. Larger studies appear towards the top of the graph (reflecting lower *SEM*), and should cluster around the mean, as they will have less sampling error. In contrast, smaller studies, appearing towards the bottom of the graph, will have a broader range of values, reflecting greater sampling error. In the absence of publication bias, the graph should resemble a funnel, as studies are symmetrically distributed around the mean effect size. In contrast, if publication bias is present, then asymmetry would be found, particularly towards the bottom of the graph, where non-significant findings may not have been published.

Heterogeneity refers to the variation in effect sizes. Specifically, the extent to which the differences between groups varies across studies. A large amount of heterogeneity may suggest there are moderating variables which are contributing to the differences found, which it is important to try and understand. Heterogeneity was assessed using chi-squared tests, where a significant *p*-value (< .05) provides evidence of more heterogeneity than

would be expected by chance. Where heterogeneity tests where significant, a subgroup analysis was carried out to test for differences between studies that included only child (< 12 years), child and/or adolescent (12-19 years), and adult participants (> 19 years). This is based on evidence from the qualitative review which suggests developmental differences may moderate the effects of sex/gender differences.

1.4.3 Results

1.4.3.1 Publication bias.

Considering the relatively small number of studies included in the analysis, it is difficult to draw definitive conclusions about publication bias (Borenstein et al., 2009). Two plots (autistic and neurotypical males; autistic and neurotypical females) showed signs of asymmetry (Figure 2). However, the studies that appeared to be missing were in line with the main findings (i.e., higher scores in neurotypical males and females relative to autistic males and females), suggesting the overall pattern of results would be the same if included. In addition, Zwetsloot et al. (2017) suggest that plotting *SMD* against the *SE* – as in the current analysis – can overestimate the existence of publication bias. The other two plots show that most studies clustered around the overall *SMD*, suggesting publication bias was not evident (Figure 3).

Figure 2: Funnel plots for analyses comparing autistic and neurotypical males (left) and autistic and neurotypical females (right)

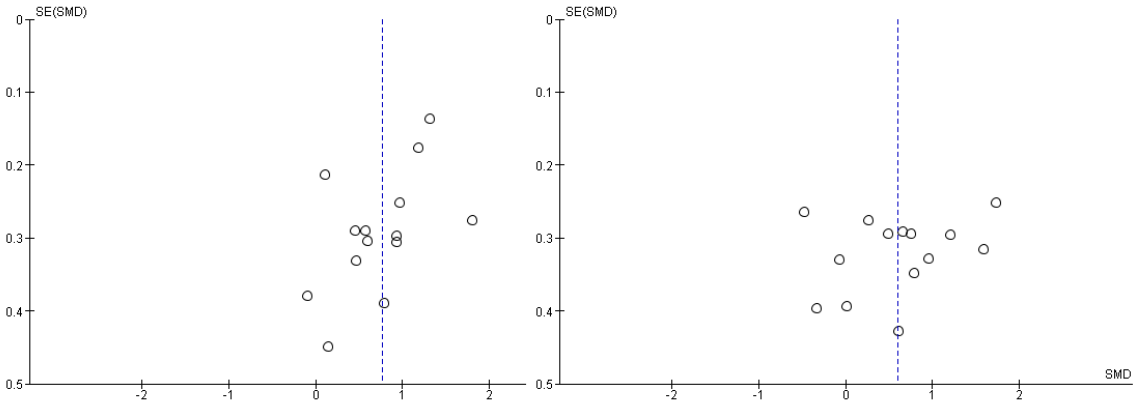
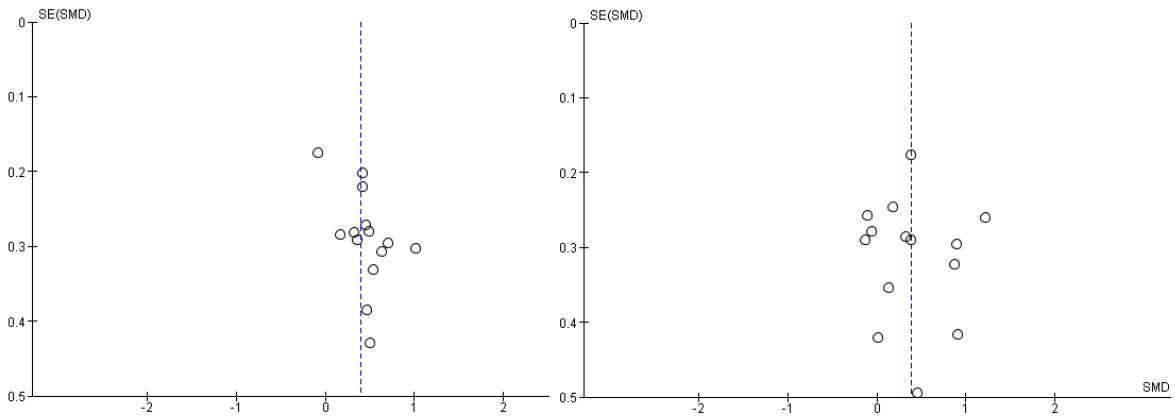


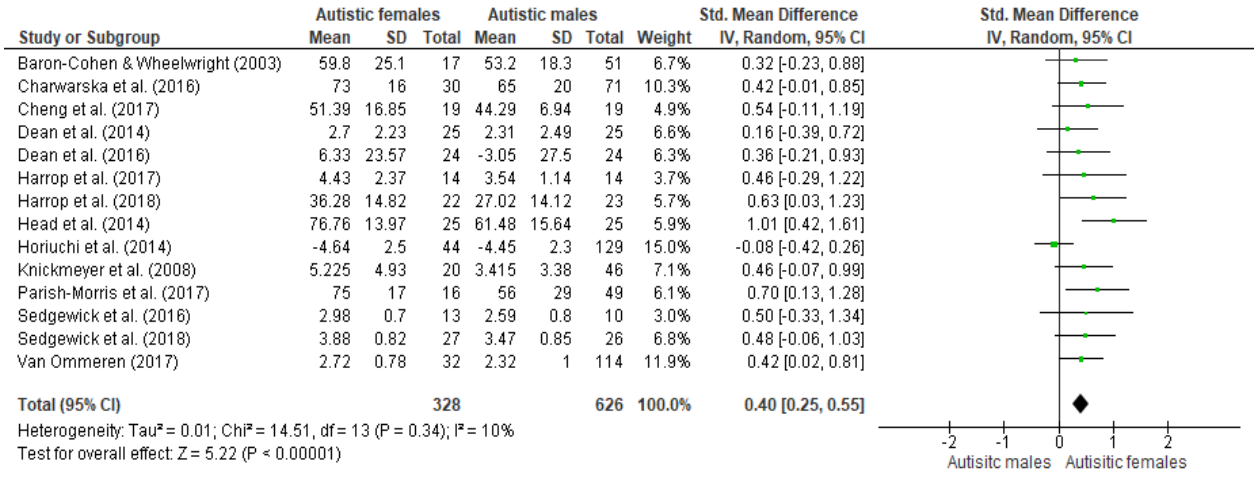
Figure 3: Funnel plots for analyses comparing autistic males and females (left) and neurotypical males and females (right)



1.4.3.2 Comparison of autistic males and females.

This random-effects meta-analysis found significant differences between autistic males and females, *SMD* = 0.40, 95% Confidence Interval (CI) = (0.25, 0.55), $p < .001$, indicating that autistic females had significantly better social communication and interaction than autistic males. Heterogeneity tests were non-significant, $\chi2(13) = 14.51$, $p = .340$, indicating the same pattern of results tended to be found across studies (Figure 4)

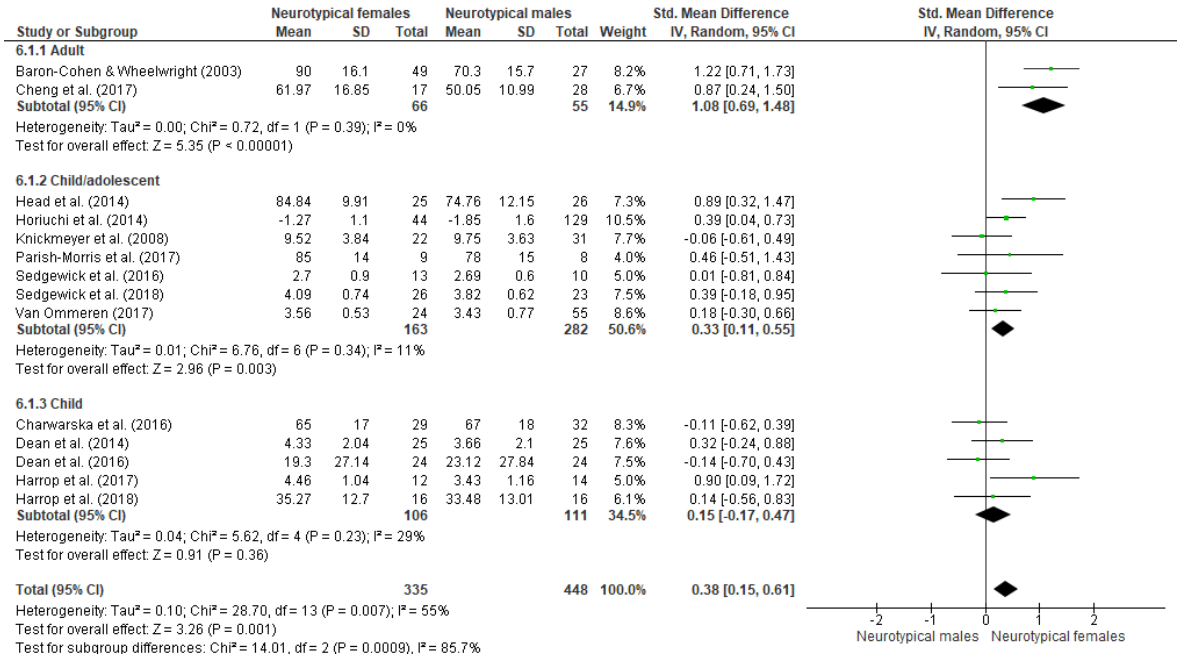
Figure 4: Forest plot for meta-analysis comparing autistic males and females.



1.4.3.3 Comparison between neurotypical males and females.

As can be seen from Figure 5, there were significant differences between neurotypical males and females, *SMD* = 0.38, 95% CI = (0.15, 0.61), p = .001, indicating that – as with autistic males and females – neurotypical females had significantly better social communication and interaction than autistic males. However, heterogeneity tests were significant, $\chi2(13) = 28.70$, p = .007, therefore we tested whether age was a moderator, which was significant, $\chi2(2) = 14.01$, $p < .001$. Females had better social communication and interaction than males for all three groups, however the difference was non-significant in studies that only included children (p = .360), but significant for studies that included children and/or adolescents (p = .003) and those that only included adults (p < .001). The *SMD* between females and males increased with age (*SMD* child > *SMD* child/adolescent > *SMD* adult). Heterogeneity tests were non-significant for the three groups, suggesting that developmental differences were accounting for the heterogeneity when all studies where included.

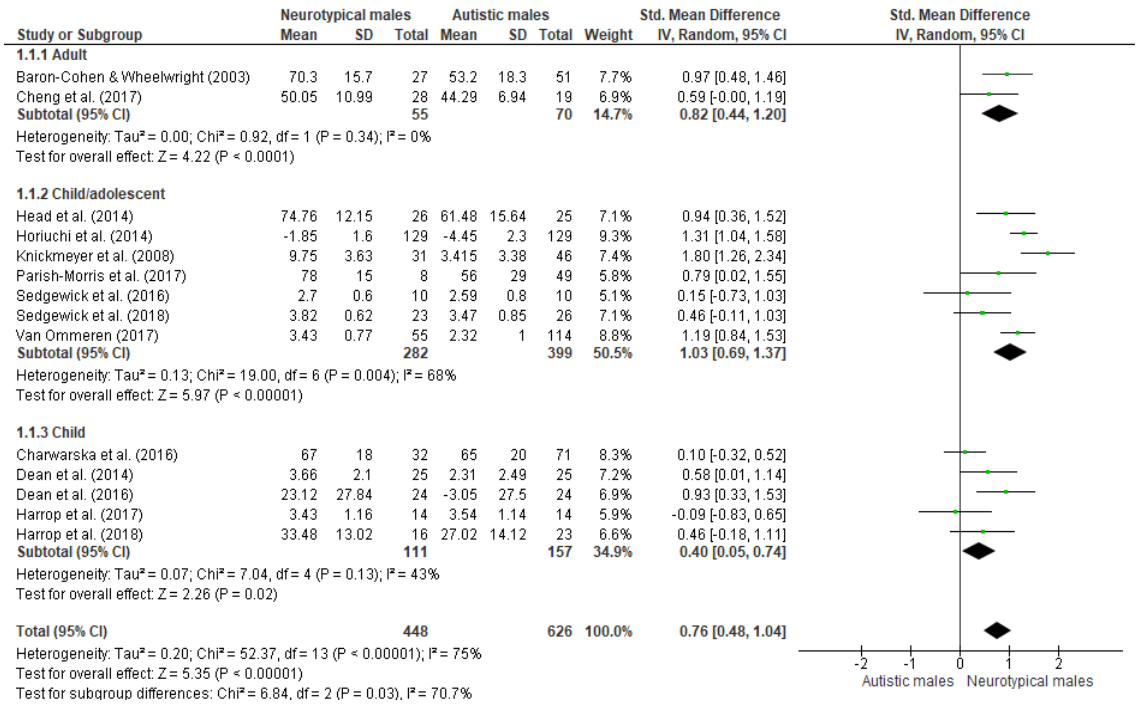
Figure 5: Forest plot and moderator analysis for meta-analysis comparing neurotypical males and females.



1.4.3.4 Comparison between autistic and neurotypical males.

As can be seen from Figure 6, there was a significant difference between autistic and neurotypical males, *SMD* = 0.76, 95% CI (0.48, 1.04), $p < .001$,indicating that neurotypical males had significantly better social interaction and communication than autistic males. However, heterogeneity tests were significant, $\chi2(13) = 52.37$, $p < .001$, therefore we tested whether age was a moderator, which was significant, $\chi2(2) = 6.84$, $p = .030$. Neurotypical males had higher social interaction and communication scores than autistic males for all age groups. However, the difference was greatest in studies that included children and/or adolescents (*SMD* = 1.03, $p < .001$). Nonetheless, there was still significant heterogeneity within this group ($p = .004$), suggesting other moderators may be affecting the difference between autistic and neurotypical males in this age group not tested for in the current analysis. There was a significant difference between autistic and neurotypical males in studies that included adult participants (*SMD* = 0.82, $p > .001$), and heterogeneity tests were non-significant ($p = .340$). There was also a significant difference for studies that only included children (*SMD* = 0.40, $p = .020$) and heterogeneity tests were non-significant ($p = .130$).

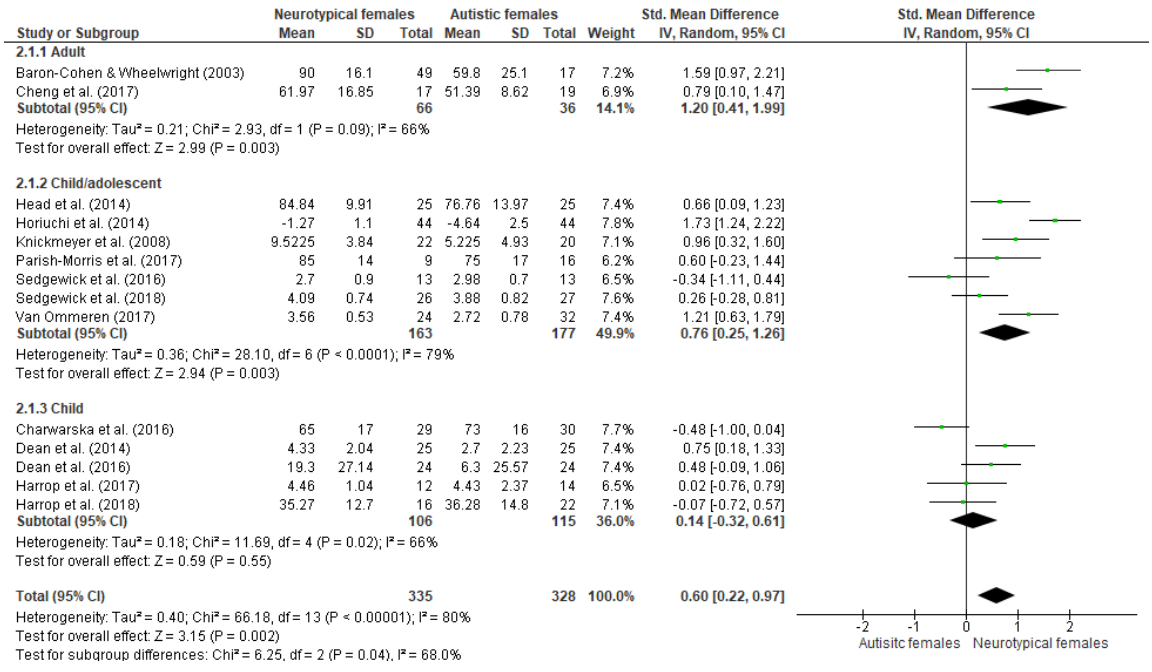
Figure 6: Forest plot and moderator analysis for meta-analysis comparing autistic and neurotypical males.



1.4.3.5 Comparison between autistic and neurotypical females.

As can be seen from Figure 7, there was a significant difference between autistic and neurotypical females – which was smaller than the difference between autistic and neurotypical males – *SMD* = 0.60, 95% CI (0.22, 0.97), *p* = .002, indicating that neurotypical females had significantly better social interaction and communication than autistic females. However, heterogeneity tests were significant, $\chi 2(13) = 66.18$, $p < .001$, therefore we tested whether age was a moderator, which was significant, $\chi 2(2) = 6.25$, *p* = .040. Similar to the pattern found in males, neurotypical females had significantly better social interaction and communication than autistic females for studies that only included adults (*SMD* = 1.20, *p* > .001) and children and/or adolescents (*SMD* = 0.76, *p* = .003). As with males, heterogeneity tests were non-significant for adult studies (*p* = .09), but significant for child and/or adolescent studies (*p* < .001), suggesting other moderators may be affecting the difference between autistic and neurotypical females in this age group not tested for in the current analysis. In contrast to males, there was no significant difference between autistic and neurotypical females for studies that only included child participants (*SMD* = 0.14, *p* = .550), although the heterogeneity test was significant (*p* = .020), suggesting other moderators may be affecting the differences found.

Figure 7: Forest plot and moderator analysis for meta-analysis comparing autistic and neurotypical females.



1.5 Discussion

This systematic review and meta-analysis investigated sex/gender differences in individuals with autism in social interaction and communication, and – if such differences were found – whether these reflect sex/gender differences found in neurotypical individuals. To overcome potential diagnostic biases against females, we focused exclusively on narrow construct domains of social interaction and communication, rather than broad construct measures, such as those that tend to be produced through 'gold-standard' instruments. We included a total of 14 studies, finding that autistic females demonstrated significantly better social interaction and communication skills that autistic males, which reflected the pattern found for neurotypical individuals. Both autistic females and males had significantly lower social interaction and communication than their neurotypical females and male counterparts; however, the difference between females was smaller than the difference between males.

Heterogeneity tests indicated that there was significant variation in all analyses, apart from the comparison of males and females with autism. In the three analyses where significant heterogeneity was found (i.e., neurotypical males and females; autistic and neurotypical males; autistic and neurotypical females), age was found to be a significant moderating variable, illustrating the importance of understanding development differences in sex/gender research. Studies that only included child participants, for example, found a significant difference between autistic and neurotypical boys, whereas there was no significant difference between autistic and neurotypical girls. In addition, the difference between neurotypical males and females increased in a stepwise manner, such that females demonstrated better social interaction and communication than males as they got older. After splitting studies into different age groups, some heterogeneity tests remained significant, highlighting the need for future research to consider other potential variables (e.g., IQ or educational context - e.g. mainstream or special needs settings) that may moderate sex/gender differences in narrow construct measures of social interaction and communication.

Two previous meta-analyses have found no significant social interaction and communication differences between autistic males and females (Hull et al., 2017a; van Wijngaarden-Cremers et al., 2014). This is probably because the results from these meta-analyses were based predominantly on data derived from diagnostic instruments (e.g., ADOS) – which tend to produce global social and communication scores – and may be biased towards a male-specific manifestation of autism (Lai et al., 2015). In contrast, in the

current study, only narrow construct measures/associated behavioural exemplars of social interaction and communication were included, and a significant difference between autistic males and females was found in these domains. As recommended by Lai et al. (2015), future sex/gender difference research should compare autistic males and females on a wider range of narrow constructs and associate behavioural exemplars, which may require the construction of new instruments.

It is important to note that although we included many of the same studies as Hull et al. (2017a), they tended to use broad construct measures of social communication and interaction for their meta-analysis (e.g., SRS scores in Sedgewick et al., 2016), whereas we used narrow construct measures (e.g., FQS scores in Sedgewick et al., 2016). Hull et al. (2017a) did include some of the same measures as the current study in their systematic qualitative review of 'additional autism spectrum conditions', such as the Friendship Survey (Dean et al., 2014). However, in the present research, these measures were conceptualised as specific examples (i.e., narrow constructs) of social interaction and communication, and therefore were included in the analysis. Significant sex/gender differences were found for autistic individuals in social communication and interaction, whereas Hull et al. (2017a) found no significant difference. This suggests that the way in which data are collected, specific measures employed, as well as data extraction criteria for reviews, can moderate the effects of sex/gender differences, which will be important for future research to explore (Rutter, Caspi, & Moffitt, 2003).

Autistic females had significantly better social interaction and communication than autistic males, which reflected sex/gender differences found for neurotypical individuals. Practitioners should therefore take normative sex/gender differences in account when assessing social and communication difficulties (Hull et al., 2017a); for example, it is possible that a female may have less severe social communication difficulties than a male in the same setting, perhaps making her less likely to be referred for assessment and receive intervention. When compared to neurotypical male and female counterparts, however, it is possible that this female could be experiencing similar, or even greater, levels of difficulties. In addition, diagnostic criteria may need to account for sex/gender differences in the general population, such as having lower cut-off scores for females than males (Lai et al., 2015). This demonstrates the importance of future research including neurotypical males and females, to ascertain whether sex/gender differences found for autistic individuals reflect those found in the general population.

The difference between autistic and neurotypical girls' social communication was smaller than the difference between autistic and neurotypical boys, which would serve to make them appear more neurotypical. For example, van Ommeren et al. (2017) found that autistic girls had more similar levels of social reciprocity to neurotypical girls, than autistic boys did to neurotypical boys. As outlined in the qualitative review, similar patterns were found in the domains of social attention, pragmatic language, peer engagement behaviours, and some aspects of peer relationships. This may in part contribute to why females tend to be diagnosed at a later age than males (Begeer et al., 2012; Giarelli et al., 2010). Interestingly, there was no significant difference between autistic and neurotypical girls for studies that included only child participants, whereas the difference was significant between autistic and neurotypical boys. In other words, the difference between autistic and neurotypical girls was smaller than the difference between autistic and neurotypical boys, providing preliminary evidence of social camouflaging (i.e., that they may be using strategies to mask their social difficulties) in young girls with autism, and therefore may make them more likely to be missed in childhood. However all but two (Charwarska et al., 2016; Cheng et al., 2017) of the studies only included individuals with clinical diagnoses of autism. It will therefore be important to include more representative general population samples (e.g., those with high traits who have not yet received a diagnosis) in future research as (1) these individuals are most likely to be camouflaging and (2) clinical samples can generate inaccurate estimates of sex/gender differences due to ascertainment bias (Rutter et al. 2003).

It is also important for future research to investigate wider sociocultural factors that may be influencing the present results (Kresier & White, 2014). For example, females tend to socialise in smaller groups than males at playtime, with greater expectation of conversation and building intimacy (Baines & Blatchford, 2009). In contrast, males tend to play in larger groups, centred around a structured activity, such as ball games (Baines & Blatchford, 2009; Pellegrini, Blatchford, Kato, & Baines, 2004). Girls with autism, therefore, may be rewarded by peers for engaging in gender-typical behaviour (e.g., conversing in small groups), which could help them develop more sophisticated communication and interaction skills. Nonetheless, there also exists the possibility of bias resulting from gender stereotypes in the present results. For example, girls with autism may be perceived as 'shy' or 'immature', as opposed to experiencing social difficulties (Attwood, 2006; Kresier & White, 2014). Questionnaires may be particularly susceptible to bias (Choi & Pak, 2005) and – considering half of studies included in the analysis were

questionnaire based – it is therefore important to employ more objective tasks in the future (Lai et al., 2015).

One limitation of the meta-analysis is the relatively small number of studies included, particularly in respect to moderator analyses, resulting from the limited number of research articles that (1) employ narrow construct measures of social interaction and communication and (2) include males and females, with and without autism. However, Borenstein et al. (2009) note that statistical summaries with a small number of studies may still be superior to drawing *ad hoc* summaries from data with unknown properties. In addition, although we conducted moderator analyses for different age groups, some heterogeneity tests remained significant, suggesting that it will be important for future research to identify other potential sex/gender moderating variables, such as IQ, ethnicity, and specific way in which social interaction and communication skills were measured (e.g., questionnaire, behavioural task, observational study).

Although not within the current study's research aims, it is important to note that measures of restricted, repetitive patterns of behaviour, interests, or activities (RRBIAs) or hyper or hyporeactivity to sensory input – both of which are part of the DSM-5 ASD diagnostic criteria – were not included, which therefore limits the conclusions that can be drawn in terms of diagnostic bias against females. Nonetheless, there are no known published studies that have investigated sex/gender differences in RRBIAs and/or hyper or hyporeactivity to sensory input that have focused on narrow constructs and have included neurotypical males and females, as per the inclusion criteria. Although research has, for example, found that autistic females demonstrate qualitatively different RRBIAs to autistic males, neurotypical males and females were not included (e.g., Hiller et al., 2014). Therefore future research should address this gap in order to establish whether our findings extend to other aspects of the ASD diagnostic criteria.

1.5.1 Conclusion

In conclusion, a systematic review and meta-analysis was conducted to investigate sex/gender differences in narrow construct measures of social interaction and communication based upon DSM-5 ASD diagnostic criteria. Evidence that girls with autism have better social interaction and communication than autistic males was found, which reflects sex/gender differences found in neurotypical individuals. In addition, neurotypical males and females had better social interaction and communication than autistic males and females, though this difference was smaller in females, providing

evidence of social camouflaging. These results may partly explain why girls with autism tend to be diagnosed at a later age than male counterparts, and suggest that ASD diagnostic criteria may need to be adapted to reflect sex/gender differences. More research is needed to compare males and females with and without autism on a broader range of narrow constructs, and to investigate potential moderating variables.

Chapter 2 An Exploration of Sex/Gender Differences in Camouflaging in Children and Adolescents on the Autistic Spectrum

2.1 Introduction

Autism spectrum disorder, or 'autism', is a neurodevelopmental disability characterised by difficulties with social interaction and communication, as well as restricted and repetitive patterns of behaviour, activities and interests (American Psychiatric Association, 2013). A growing body of research suggests that autism may manifest differently in females, and specifically in the domains of social and interaction and communication, which has led some researchers to suggest there may be a female-specific phenotype of autism (e.g., Lai et al., 2015). Autism affects approximately 1% of the population, and is diagnosed more frequently in males than females, with an approximate ratio of four males to every female typically being cited (Fombonne, 2009). Relatively recent large-scale population studies have, however, reported a ratio of approximately three females to every male (e.g., Baxter et al., 2015; Zablotsky, Black, Maenner, Schieve, & Blumberg, 2015), which may reflect increased clinical awareness to the female phenotype (Lai et al., 2016). Research studies have increasingly aimed to explore the possibly that there may be a differential phenotypic profile in autism between males and females.

Camouflaging, defined as the use of compensatory behaviours to mask social difficulties, is thought to be a key feature of the female autistic phenotype (Hull et al., 2019; Wood & Wong, 2017, for a review). Two broad approaches to studying and operationalising camouflaging can be distinguished and include 'social camouflaging' and 'compensation'[2]. Social camouflaging refers to any behaviour that makes individuals with autism appear more similar to neurotypical peers. In contrast, compensation is defined as 'the processes contributing to improved behavioural presentation of a neurodevelopmental disorder despite persisting core deficit(s) at cognitive and/or neurobiological levels' (Livingston & Happé, 2017, p. 731). This gender difference may increase challenges to

[2] Social camouflaging and compensation loosely correspond to what Hull et al. (2019) define as 'observational/reflective' and 'discrepancy methods' to measuring camouflaging.

identify females with autism and contribute to the later diagnosis for this group (e.g., Begeer et al., 2012; Giarelli et al., 2010). Late diagnosis in general, and camouflaging in particular, are associated with increased mental health difficulties (e.g., Hull et al., 2019; Lai & Baron-Cohen, 2015) and has been found to be a risk marker for suicidality (Cassidy, Bradley, Shaw, & Baron-Cohen, 2018). It is therefore important to investigate gender differences in social camouflaging and compensation to facilitate earlier identification and intervention for females (Lai et al., 2016).

Camouflaging has been investigated via qualitative and quantitative research methods. Several qualitative studies have explored the experiences of females diagnosed with autism and these studies have resulted in rich and detailed accounts of this phenomenon (e.g., Bargiela, Steward and Mandy, 2016; Cridland, Jones, Caputi and Magee, 2014; Hull et al., 2017b; Tierney, Burns and Kilbey, 2016). For example, Tierney et al. (2016) interviewed ten adolescent girls with autism to explore their experiences of social relationships, all of whom described using 'masking' strategies to appear more socially competent which was motivated by a desire for friendship. However, many adolescents indicated that the use of these cognitively demanding strategies resulted in adverse psychological consequences. For example, one adolescent described an 'identity crisis', attributed to 'pretending to be the same as everyone else' (Tierney et al., 2016, p. 79). In addition, eight adolescents had been referred to mental health services, which may reflect the challenges of managing social situations. Adolescence is a period of particular challenge in which social difficulties can be exacerbated, that is due in part to the increased social demands associated with this period (e.g. Gould & Ashton-Smith, 2011), which may be most acute for females (review by Pickering, Hadwin & Kovshoff, 2019).

In a further study, Cridland et al. (2014) interviewed three adolescent autistic girls, their mothers, and two other mothers who also had autistic daughters. All the girls experienced difficulties developing and maintaining friendships; maternal reports suggested these difficulties may, in part, have resulted from reliance on imitation during childhood in an attempt to mask underlying social deficits. Consistent with the results of Tierney et al. (2016), however, one mother reported that these strategies 'fell apart' during adolescence partly due the 'increasing complexity of adolescent female friendships' (Cridland et al., 2014, p. 1266-7.). The authors argued that difficulties with social relationships are a key reason why more girls, than boys, with autism experience

internalising mental health conditions such as anxiety, depression, and eating disorders (Muller, Schuler and Yates, 2008; Mandy et al., 2012; Rivet and Matson, 2011).

Similar themes were found in a study that involved interviewing 14 autistic women diagnosed in late adolescence or adulthood (Bargiela et al., 2016). Detailed accounts of 'pretending to be normal' (p. 3287) were given in which young adults reported using explicit strategies in an attempt to fit in with peers. These included using learnt phrases and facial expressions from TV, books and magazines, social imitation, and masking autistic traits. In addition, eight women believed that when they were teenagers, their peers were noticeably more advanced in their social abilities, leading to difficulties forming friendships and feelings of 'rejection'. The majority of women also reported having experienced a mental health condition, with depression, anxiety and eating disorders being the most common. One further study involved interviewing 92 male and female adults with autism about camouflaging, highlighting a similar desire to fit in and connect with others, and resulting in both positive (e.g., success in jobs and relationships) and negative (e.g. exhaustion, loss of identity) consequences (Hull et al., 2017b). In this case camouflaging was reported in a similar number of males and females, as well as all participants who identified as non-binary.

Collectively, the research in this area indicates a need for further studies that can build on these findings to compare the prevalence of camouflaging in autistic males and females, as well as neurotypical males and females, and to disentangle the effects of sex and gender on potential differences in the autism phenotype. Considering evidence for social camouflaging, if autistic females present as more behaviourally similar to their neurotypical peers than autistic males, this finding would provide evidence of social camouflaging in females, according to the aforementioned definition. However, it is possible that this could also reflect bias in the observer and/or observational method, which should also be considered. Any demonstration of compensation should, however, include observations of behaviour and cognition and/or neurobiology; if, for example, females have more advanced social behaviour than males, despite similarly low levels of social cognition (e.g., theory of mind), this would provide evidence of more compensation in females.

Several experimental studies have found that the difference between social interaction and communication skills in autistic and neurotypical females was smaller than

the difference between autistic and neurotypical males, providing preliminary evidence of greater levels of social camouflaging in girls with autism. For example, Dean et al. (2017) examined the behaviours of children, aged 7.7 years on average, both with and without autism on the playground. They found that autistic girls tended to stay in close proximity to peers, weaving in and out of activities. Similarly, neurotypical girls spent the majority of their time socialising with peers. In contrast, autistic boys spent most of their time alone, whilst neurotypical boys mostly played games. Consequently, girls – but not boys – with autism looked similar to neurotypical peers. A further study investigated gender differences in social reciprocity for children with an average age of 12.6 years, and found that girls with autism had significantly higher reciprocity scores than males with autism, and more in line with neurotypical counterparts, thus demonstrating social camouflaging (van Ommeren et al., 2017). One further study in children with an average age of 10.7 years, similarly found that girls with autism used a pragmatic marker ('um' relative to total amount of 'um' and 'uh') comparably to neurotypical girls. Boys with autism used this pragmatic markers significantly less than neurotypical boys (Parish-Morris et al., 2017). The authors argued that this usage served as a form of 'linguistic camouflage' (a specific form of social camouflaging).

Whilst studies have found evidence for social camouflaging in females (versus males) with autism, researchers have highlighted that relatively little research has investigated compensation in general (Livingston, Colvert, Bolton, & Happé, 2018). One study found that the discrepancy between inter-social behaviour – as measured by the ADOS – and self-reported autistic traits/theory of mind ability was significantly greater for adult females than males; females and males had similar theory of minds scores, but females had significantly more advanced social communication, thereby providing evidence of higher levels of compensation in adult autistic females (Lai et al., 2016). Rynkiewicz et al. (2016) found that girls (aged 5-10 years) with autism presented with better non-verbal communication than boys with autism on two activities from the ADOS, despite having lower social-cognitive ability, again providing evidence of higher levels of compensation in autistic females. Livingston et al. (2018) found that females who demonstrated high levels of compensation (i.e., good social skills, despite poor theory of mind) had significantly higher IQ than those who did not show this differential profile. Moreover, compensation behaviour was most evident in females; the male-to-female ratio

for individuals who showed little compensation was 4.71:1, compared with a ratio of 3.67:1 for individuals who demonstrated higher levels of compensation.

Preliminary findings indicate that social camouflaging and compensation may be greater in autistic females than males, and that, irrespective of gender, high levels of compensation might be associated with higher IQ. High compensation may also be particularly linked to the development of internalising disorders. However, studies that have explored the emergence of these behaviours in young children with autism are scarce. Moreover, no study has included children with high levels of autistic traits who have not yet received a diagnosis. By definition, those children who are camouflaging are less likely to have received a diagnosis – especially earlier in age – as they will, at least to a degree, have masked their social difficulties. Accordingly, this study aimed to replicate and extend existing research to explore social camouflaging and compensation in children with high levels of autistic traits (with and without diagnoses of autism), with a specific focus on reciprocal behaviour, in order to address the following research questions:

(1) Do child and adolescent females with autism engage in higher levels of social camouflaging than males with autism?

(2) Do child and adolescent females with autism engage in higher levels of compensation than males with autism?

(3) Irrespective of gender, are higher levels of compensation associated with higher levels of IQ?

It was hypothesised that social camouflaging would be most evident in autistic girls; the difference in reciprocity for girls with and without autism/high autistic traits would be smaller than the difference between reciprocity scores for boys with and without autism/high autistic traits. To explore compensation, we measured social cognitive abilities and hypothesised that increased reciprocity in females (versus males) with autism would be evident despite a similar level of social-cognitive ability (i.e., theory of mind) between genders. Finally, it was expected IQ would be higher in children with autism/high autistic traits who displayed higher levels of compensation than those who displayed little compensation, irrespective of gender.

2.2 Method

2.2.1 Power Analysis

The current study utilised the Interactive Drawing Task (IDT, van Ommeren, Begeer, Scheeren, & Koot, 2012) to provide an index of reciprocity. Only one study (van Ommeren et al., 2017) has previously investigated sex/gender differences using this task. A power analysis using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) was conducted when designing the study, using the effect size of the difference between autistic and neurotypical males ($\eta^2_P = 0.24$) from van Ommeren et al. (2017); this analysis showed that a minimum of 59 participants were needed to achieve 95% power.

2.2.2 Participants

Special Educational Needs Coordinators (SENCos) and/or Head Teachers from 16 mainstream primary schools and three mainstream secondary schools in the South of England were approached to ask if their school would be interested in participating in the study. Of these, ten primary and two secondary schools agreed to participate. The reason for non-participation was lack of time ($n = 4$). SENCos from the participating schools either sent letters to parents of all eligible children and/or approached specific parents of children with autism diagnoses or high autistic traits. Parents were asked to read an information sheet (Appendix F), complete the Social and Communication Disorders Checklist (SCDC, Skuse, Mandy, & Scourfield, 2005), and sign a consent form (Appendix G) if they were happy for their child(ren) to take part. Children also gave their assent (see Procedure section below).

Table 7 shows the sample characteristics. The final sample comprised 84 children (22 boys with autism/high autistic traits, 18 girls with autism/high autistic traits, 22 neurotypical boys, 22 neurotypical girls) aged between 8-14 years. To test for pre-existing differences in verbal IQ, non-verbal IQ, full-scale IQ, and age, we ran a series of 2X2 between subject ANOVAs comprising the following groups: 2 Gender (girls; boys) and 2 Group (neurotypical; autism/high autistic traits). All main effects and interactions were non-significant (all ps > .116), besides a main effect of group for verbal IQ ($p = .012$), which indicated that neurotypical participants had significantly higher verbal IQ scores than participants with autism/high autistic trait.

Table 7: Descriptives, total IDT and total RMET-C scores for boys and girls in the autism/high autistic traits and neurotypical groups

	Autism/high autisitc traits (n = 40)				Neurotypical (n = 44)			
	Boys (n = 22)		Girls (n = 18)		Boys (n = 22)		Girls (n = 22)	
	M (SD)	Range	*M (SD)*	Range	*M (SD)*	Range	*M (SD)*	Range
Age in years	10.08 (1.75)	8.08-13.92	10.12 (1.43)	7.92-13.42	10.50 (1.40)	8.58-14.42	9.62 (1.01)	8.08-11.5
T score for Vocabulary subtest of WASI-II	52.91 (10.03)	38-77	52.56 (12.16)	27-67	58.95 (7.15)	45-72	57.05 (7.77)	42-70
T score for Matrix reasoning subtest of WASI-II	46.50 (12.34)	31-72	46.39 (9.16)	35-66	49.64 (8.27)	27-60	44.59 (10.05)	22-60
Composite Score for Full Scale IQ	99.55 (17.58)	76-142	99.00 (15.68)	71-120	107.59 (12.36)	84-128	101.41 (14.18)	70-119
Total IDT score	2.16 (1.13)	0.22-3.92	2.91 (0.99)	1.33-4.63	3.22 (1.05)	1.00-4.53	2.86 (1.12)	1.00-4.60
Total RMET-C score	17.68 (4.09)	9-26	17.56 (4.59)	8-24	19.05 (2.50)	15-23	18.32 (3.64)	12-26

Of the 22 boys in the autism/high autistic traits group, eight had a clinical diagnosis of Autism Spectrum Disorder (ASD) and two had a diagnosis of Asperger's Syndrome, all confirmed by a paediatrician. The other 12 participants in this group exceeded cut-off (M = 14.33, SD = 3.99) on the SCDC and were either under assessment for ASD (n = 10), or concerns had been raised in respect to possible autism/social communication difficulties by school and parent. There was no difference between boys who had a clinical diagnosis and those who had high traits without a diagnosis in respect to the two outcome measures of theory of mind (p = .224) or social reciprocity scores (p = .450).

Of the 18 girls in the autism/high autistic traits group, eight had a clinical diagnosis of ASD confirmed by a paediatrician. The other 10 in this group exceeded cut-off (M = 17.43, SD = 5.91) on the SCDC, and were either under assessment for ASD (n = 8), had been assessed for ASD and found to have a high level of traits just below clinical cut-off level (n = 1), or concerns had been raised in respect to possible autism/social communication difficulties by school and parent (n = 1). There was no difference between girls who had a clinical diagnosis and those who had high traits without a diagnosis in respect to the two outcome measures of theory of mind (p = .582) or social reciprocity scores (p = .555).

2.2.3 Measures

2.2.3.1 Autistic traits.

The SCDC (Skuse et al., 2005, Appendix E) is a parent completed 12-item checklist designed to measure autistic traits in the general population. Parents are required to answer 'not true' (0), 'quite or somewhat true' (1), or 'very or often true' (2) to questions about their child's behaviour in the last 6 months, such as 'does not pick up on body language.' The possible score range is 0 - 24 and a score of nine or above suggests the individual may have autism. Skuse et al. (2005) found the SCDC to have excellent internal consistency

(.93), high test-retest reliability (.83), good discriminative validity from other developmental disorders, and even better discrimination from non-clinical samples; sensitivity (.90), specificity (.69). The SCDC has been used frequently in published research to measure autistic traits (e.g., Pickard, Happé, & Mandy, 2018).

2.2.3.2 Intelligence quotient.

The Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II, Weschler, 2011) is a short intelligence test. We used one verbal (Vocabulary) and one performance (Matrix Reasoning) subtest, allowing us to estimate verbal and nonverbal IQ, as well as combine them to generate a full-scale IQ estimate. McCrimmon and Smith (2013) note that the WASI-II has good-to-excellent internal consistency (.87 - .91), acceptable to excellent test-retest stability (.79 - .90), acceptable-to-excellent concurrent validity (.71 - .92), excellent interrater reliability (.94 - .99), as well as strong factor validity.

2.2.3.3 Social reciprocity.

The IDT (van Ommeren et al., 2012, 2017) is a measure of social reciprocity. The measure involves a researcher and participant taking turns to create a drawing. The total IDT score is made up of four sub-scale scores that are generated as a proportion of the total number of turns, and include (1) turn-taking (pushing and rotating the paper back to the researcher once the participant has finished their turn) (2) reciprocal interaction (collaborating with researcher in contributing a meaningful element to a mutual object), (3) reciprocal interaction in the other's initiative (each time the participant contributes to an object initiated by the researcher) and (4) reciprocal flexibility (each time the participant accepts an interfering input to the picture), which are summed to form a total IDT score. For a detailed description of the IDT, consult van Ommeren (2018). Upon completion, all participants are asked to rate their enjoyment of the task by choosing a smiley ranging from 5 ('liked it very much;) to 1 ('did not like it at all'). van Ommeren, Koot, Scheeren, and Begeer (2015) found the IDT demonstrated excellent inter-rater reliability (.95 - 1.00), moderate-to-good test retest reliability (.47 - .70), and excellent criterion validity.

2.2.3.4 Theory of mind.

The reading the mind in the eyes test, Child's Version. (RMET-C, Baron-Cohen, Wheelwright, Spong, Scahill, & Lawson 2001) was used to measure theory of mind (i.e., the ability to recognise the mental state of others). Participants were shown 28 pictures of an individual when only their eye region is visible with four words written around it. Participants were read the four words and asked to choose the word 'that best describes what the person in the picture is thinking or feeling.' The child's version was developed from the adult version of the test (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001), which has been used in over 250 published studies (Baker, Peterson, Pulos, & Kirkland, 2014), including autism sex/gender difference research (e.g., Lai et al., 2016). Children with Asperger's Syndrome have previously been found to score significantly lower than control children (Baron-Cohen et al., 2001), indicating that the RMET-C is able to capture theory of mind differences between autistic and neurotypical children.

2.2.4 Design

A 2x2 between subject design was employed comprising the following groups: 2 Gender (girls; boys) and 2 Group (neurotypical; autism/ high autistic traits). The dependent variables were social reciprocity and theory of mind. We included verbal IQ as a covariate for the main analyses, due to fact that neurotypical participants had significantly higher verbal IQ than participants with autism/high autistic traits.

2.2.5 Procedure

All participants took part in the study in a quiet room in their school and worked with one of two researchers. Before taking part, participants were given an information sheet explaining the purpose of the study, which they were read if they were not proficient readers (Appendix H); they were reminded that they did not have to take part if they did not want to, that they could stop at any time, at that all information they gave was confidential. If they were happy to take part, the children were then asked to give their assent by signing a consent form (Appendix I).

All participants completed the research in the following order: (1) IDT, (2) RMET-C, (3) WASI-II. In addition, all participants completed a further task (not reported here) that involved a semi-structured interview asking them about the drawing task they had

completed, what a friend or family member would think of the drawing task, and to describe their favourite game or hobby. In total, the tasks took between 45-60 minutes per participant to complete. All participants were then thanked, fully debriefed, and reminded they could still decide to not take part if they wished. No participants requested to withdraw from the study.

2.2.6 Ethical Considerations

This study was approved by the University of Southampton's Ethics and Research Governance Online (EGRO), ID: 32187. One key ethical consideration was that we included children and adolescents who had high levels of parent-reported autistic traits, but did not have a diagnosis. It was decided to only include children whom school and parents were already concerned may have autism. This overcame the potential difficult scenario of having a group of children who had been rated as having high levels of autistic traits, but where there were no autism-related concerns. However, other important ethical considerations remained. For example, many of the children included in the study were undergoing diagnostic assessment for autism. Their parents may have perceived inclusion in this study as implicit evidence that their child did indeed have autism. In order to address this, I made it clear that this study was separate to any ongoing diagnostic assessment and that feedback for individual children could not be given, as per ethical approval. One parent asked in advance of her child taking part whether she could use the results as evidence for a diagnostic assessment. I spoke to my supervisors, as well as a legal advisor from the university; after discussion, it was decided that we would not be able to make feedback available to parents without first amending our ethics application (as I explained to children their participation was confidential). The parent understood this, seemed happy I had taken the time to consider her request seriously, and agreed for her daughter to take part anyway. No ethical problems arose during the course of the research project.

2.3 Results

2.3.1 Social Camouflaging

2.3.1.1 Parametric assumptions.

One participant (neurotypical girl) had a very low total IDT score and was investigated as a possible outlier. This participant had a total IDT score of 0.08 (2.49 standard deviations below the mean for neurotypical participants). Besides this participant, scores in the neurotypical group ranged from 1.00 - 4.60 (M = 3.04, SD = 1.09), suggesting the participant is from a different population (i.e., non-neurotypical) than the one in question, which would justify removal from the analysis (Field, 2013). As a general rule of thumb, data points with a Cook's distance of three times the mean are possible outliers (Algur & Biradar, 2015); this participant had a Cook's distance of 0.081, which is 6.75 times greater than the mean of 0.012, suggesting she was exerting undue influence on the overall results. Consequently, this participant was removed from the following analyses.

From inspection of histograms and Q-Q plots, the data looked normally distributed for all groups. In addition, Shapiro-Wilk (S-W) tests were non-significant for all groups (all ps > .089) indicating the assumption of normality had been met. Levene's test was non-significant (p = .723), indicating that the assumption of homogeneity of variance had been met.

2.3.1.2 Exploratory correlations.

Exploratory correlations showed that there were no significant correlations between total IDT scores and full-scale IQ, r = .08, p = .486, or between total IDT scores and age, r = .18, p = .100.

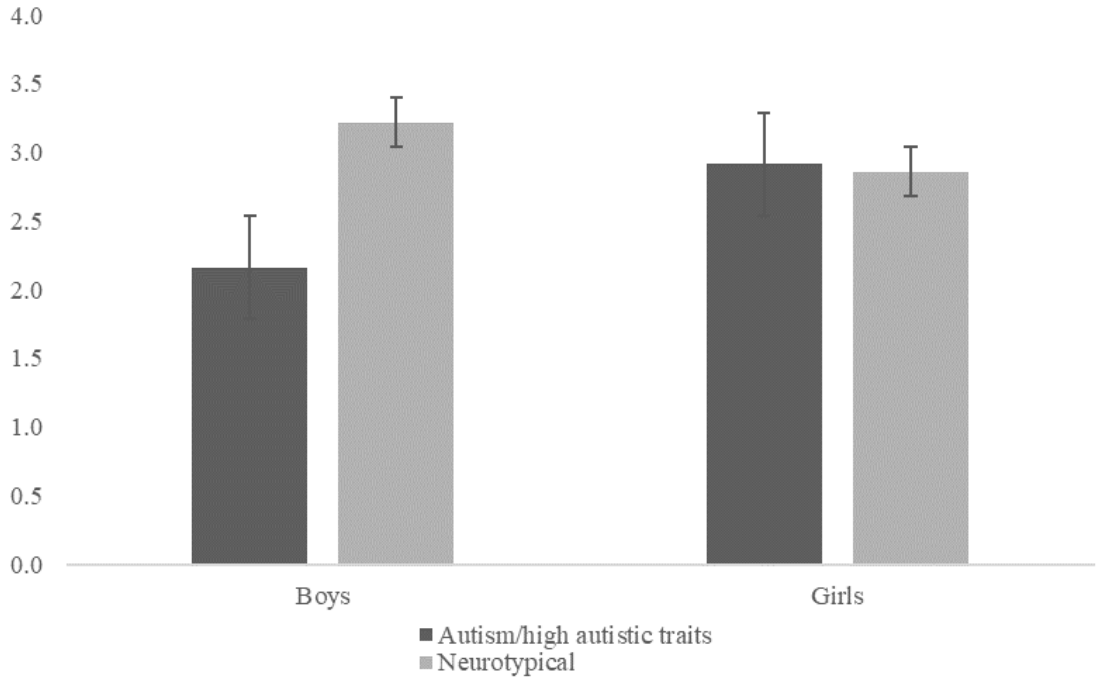
2.3.1.3 Enjoyment of IDT.

A 2X2 between-subjects ANOVA was conducted for enjoyment, with the factors of 2 Gender (girls; boys) and 2 Group (neurotypical; autism/ high autistic traits). There was no significant main effect of group (p = .342), gender (p = .826), nor a significant interaction between the two (p = .510), suggesting all participants enjoyed the IDT equally.

2.3.1.4 Total IDT scores.

A 2X2 between-subjects ANCOVA was conducted for total IDT scores (Table 7), with the factors of 2 Gender (girls; boys) and 2 Group (neurotypical; autism/ high autistic traits), and the covariate of verbal IQ. This showed a significant main effect of group, $F(1, 78) = 4.29$, $p = .042$, $\eta^2_P = .052$, reflecting lower total IDT scores in the autistic/high autistic traits, compared to neurotypical group. There was no significant main effect of gender, $F(1, 78) = 0.65$, $p = .425$, $\eta^2_P = .008$, indicating that overall males and females had similar total IDT scores. There was a significant group by gender interaction, $F(1, 78) = 5.41$, $p = .023$, $\eta^2_P = .065$. As can be seen from Figure 8, this interaction indicated that neurotypical boys had significantly higher total IDT scores than boys with autism/high autistic traits, $t(42) = 3.19$, $p = .003$, and represented a very large effect, $d = 0.96$; in contrast, there was no significant difference between neurotypical girls and girls with autism/high autistic traits, $t(37) = -0.17$, $p = .870$, which represented a negligible effect, $d = 0.05$. Conversely, girls with autism/high autistic traits had significantly higher total IDT scores than boys with autism/high autistic traits, $t(38) = 2.20$, $p = .035$, $d = 0.71$, whereas there was no significant difference between neurotypical girls and boys, $t(41) = -1.08$, $p = .284$, $d = 0.33$.

Figure 8: Total IDT scores for boys and girls in the autism/high autistic traits and neurotypical groups.



2.3.2 Compensation

2.3.2.1 Parametric assumptions.

From inspection of histograms and Q-Q plots, the data was normally distributed for all groups for total RMET-C scores. In addition, S-W tests were non-significant for all groups (all *p*s > .166), indicating the assumption of normality had been met. Levene's test was non-significant ($p = .217$), indicating the assumption of homogeneity of variance had been met. Inspection of boxplots revealed the presence of two possible outliers (both females with high autistic traits); these participants were retained in the analysis as (1) there was no reason to believe they came from a different population than the one in question and (2) statistical results were the same whether they were included or excluded.

2.3.2.2 Exploratory correlations.

Exploratory correlations showed that there was no significant correlation between RMET-C scores and age, $r = .17$, $p = .127$. However, there was a significant positive correlation between full-scale IQ and theory of mind scores, $r = .328$, $p = .002$, indicating that those with higher IQ scores tended to achieve better theory of mind scores. This effect was being driven completely by a highly significant positive correlation between IQ and theory of mind scores, $r = .601$, $p < .001$, for participants with autism/high autistic traits IQ, because there was a negligible non-significant negative correlation between neurotypical participants IQ and theory of mind, $r = -.130$, $p = .400$.

2.3.2.3 Theory of mind.

A 2X2 between-subjects ANCOVA was conducted for RMET-C scores (Table 7), with the factors of 2 Gender (girls; boys) and 2 Group (neurotypical; autism/ high autistic traits), and the covariate of full-scale IQ (due to the fact that IQ was found to correlate significantly with RMET-C scores). There was no significant main effect of group ($p = .405$), gender ($p = .828$), nor the interaction between the two ($p = .913$), suggesting that overall all participants had similar theory of mind scores. The same results were found when including no covariate. To confirm there were no differences between girls and boys

with autism/high autistic traits, an independent samples t-test was run, finding there was no significant difference between RMET-C scores for girls and boys with autism/high autistic traits, $t(38) = 0.092$, $p = .927$.

2.3.2.4 Compensation and IQ

Participants who engage in higher levels of compensation have good reciprocity despite low theory of mind scores. In contrast, those who engage in little compensation have both low reciprocity and theory of mind. To test whether there were differences in IQ between these two groups, participant groups were split at the mean for reciprocity (IDT scores = 2.78) and theory of mind (RMET scores = 18.11) and an independent samples t-test was run to compare those with low theory of mind and reciprocity (below the mean for both variables) to those with low theory of mind (below the mean) and high reciprocity (above the mean).

Table 8: IQ scores and gender ratio for particpants in the autism/high autisitc traits and neurotypical groups who engage in low and high levels of compensation

	Autism/high autisitc traits ($n = 23$)		Neurotypical ($n = 21$)	
	Low compensation ($n = 12$)	High compensation ($n = 11$)	Low compensation ($n = 10$)	High compensation ($n = 11$)
Mean full-scale IQ (*SD*)	87.25 (15.43)	96.73 (14.26)	105.30 (11.43)	106.36 (13.55)
Gender ratio (male to female)	8:4	6:5	4:6	5:6

As can be seen from Table 8, participants with autism/high autistic traits who engaged in high levels of compensation had higher IQ scores than participants with autism/high autistic traits who engaged in low levels of compensation, which, although non-significant, $t(21) = 1.53$, $p = .142$, represented a medium-to-large effect, $d = 0.64$. This non-significant result likely reflects a lack of power, as there were only 11 high and 12 low compensators in the autism/high autistic traits group respectively. In contrast, neurotypical participants who engaged in high levels of compensation had very similar IQ scores to neurotypical participants who engaged in low levels of compensation, which was non-significant, $t(19) = 0.19$, $p = .849$, and represented a very small effect, $d = 0.08$.

2.4 Discussion

The aim of this study was to investigate gender differences in social camouflaging and compensation in children and adolescents, both with autism/high autistic traits and neurotypical. The results provide evidence of social camouflaging in girls with autism/high

autistic traits, but not boys. Specifically, they highlight that girls with autism/high autistic traits had significantly higher levels of social reciprocity than boys with autism/high autistic traits. In addition, they showed similar levels of social reciprocity to neurotypical girls, whereas boys with autism/high autistic traits had significantly lower levels of social reciprocity than neurotypical boys. The study also provided evidence for compensation, where despite higher levels of reciprocity, girls with autism/high autistic traits had similar levels of social cognitive ability (theory of mind) to boys with autism/high autistic traits. The results also indicated that, irrespective of gender, children and adolescents with autism/high autistic traits who demonstrated compensation (i.e., poor theory of mind, good social reciprocity) had higher IQ than those individuals who demonstrated low levels compensation (i.e., poor theory of mind, poor social reciprocity). However, this latter finding was non-significant, though group differences reflected a medium-to-large effect.

The findings are in accordance with a growing body of literature that suggests camouflaging is key part of the female autism phenotype and is more prevalent in autistic females than males (e.g., Dean et al., 2017; see Wood & Wong, 2017, for a review). The results also fit with an emerging set of studies that have demonstrated greater levels of compensation in autistic females (e.g., Lai et al., 2016) and with the proposition of an 'improved behavioural presentation of a neurodevelopmental disorder despite persisting core deficit(s) at cognitive and/or neurobiological levels" (Livingston and Happé , 2017, p. 731). This study extends previous findings by directly investigating social camouflaging in children and young adolescents with high levels of autistic traits, but who have not received a clinical diagnosis (by definition, participants that are camouflaging are less likely to have received a diagnosis, as they would have, to some degree, masked their social difficulties).

One previous study has investigated gender differences in social reciprocity (van Ommeren et al. 2017), and our results are similar in that girls with autism/high autistic traits had higher reciprocity than boys with autism/high autistic traits, and the difference between girls with and without autism/high autistic traits was smaller than boys with and without autism/high autistic traits (i.e., demonstrating social camouflage in girls with autism/high autistic traits). In contrast, however, we found no significant difference between girls with and without autism/high autistic traits. This is partly because girls with autism/high autistic traits in this study had slightly higher reciprocity scores than those in the van Ommeren et al. (2017) study, which would be expected as it included girls without

diagnoses, all of whom attended mainstream schools. In contrast, girls in the van Ommeren et al. (2017) study all had diagnoses and attended special schools. However, neurotypical girls in our study had lower reciprocity scores those in the van Ommeren paper which may reflect developmental differences, as the girls in this study were, on average, four years younger.

Lai et al. (2016) found that autistic adult males and females had similar theory of mind scores, but females had significantly better behavioural presentation (reflecting significantly lower ADOS social communication scores); our findings replicate these in a sample of children and adolescents, with a different measure of behavioural presentation. Livingston and Happè (2018) found that autistic adolescents who demonstrated higher levels of compensation had significantly higher IQ scores than those that demonstrated low levels of compensation, and that females were non-significantly more likely to be in the high (than low) compensation group. Within our sample, participants with autism/high autistic traits who engaged in high levels of compensation also had non-significantly higher IQ than those who engaged in low levels of compensation. It was also found that females with autism/high autistic traits group were more likely to be in the high, than low, compensation group; reflecting ratios of 1.2:1 males to females in the high compensation group and 2:1 males to females in the low compensation group respectively. However, this is based upon a very small number of participants, and should be interpreted with caution.

IQ scores were positively correlated with theory of mind (RMET-C) scores in the autism/high autistic traits, but not neurotypical group, possibly because participants with autism/high autistic traits who performed well in the theory of mind task were able to use their IQ to compensate for core theory of mind difficulties. For example, it is possible that individuals with good memory (a component of IQ) may be able to remember many facial expressions, as well as which emotions they are associated with, without fully or intuitively understanding the emotion or expression. This is one possible mechanism by which individuals with autism who have higher IQ could compensate for theory of mind difficulties. However, future research is needed to systematically test this hypothesis before conclusions can be drawn. In a meta-analytic study, Baker et al. (2014) found a small, but significant, correlation between IQ and RMET scores, suggesting our association between theory and mind and IQ would be expected. However, only two of these studies included children with autism diagnoses, suggesting more research is needed in this area. In addition, the effect size we found (r = .60) between IQ and theory of mind is

much larger than that found in the meta-analysis (r =.22 in children), suggesting unaccounted variance, which may be attributable to some participants with autism/high autistic traits using IQ to compensate for theory of mind difficulties. We also found no association between IQ and theory of mind in the neurotypical group, suggesting IQ was not needed for these children to do well at the task, perhaps because it was more intuitive to them.

Although previous gender difference research has found differences between autistic and neurotypical girls (e.g., Parish-Morris et al., 2017; van Ommeren et al. 2017), these have almost exclusively only included girls with diagnoses of autism. Girls with autism/high autistic traits in this study performed almost identically in terms of their social reciprocity to neurotypical girls. A key question therefore remains: how can practitioners differentiate between autistic girls who may be camouflaging (who have not received a diagnosis) and neurotypical girls? Anecdotally, after becoming aware of which girls were in the autism/high autistic traits group, researchers noticed that some girls with autism/high autistic traits appeared to be slower to understand the nature of the task, copied the researcher, and employed rule-based strategies to complete the IDT. This is in accordance with qualitative literature that suggest autistic females often rely on imitation and develop explicit strategies to help them overcome social difficulties (e.g., Bargiela et al., 2016; Hull et al., 2017).

Several findings have indicated that girls tend to be diagnosed later than autistic boys who, despite having similar levels of autistic traits, require more behavioural and/or cognitive difficulties to be diagnosed (Begeer et al., 2013; Dworzynski et al., 2012; Giarelli et al., 2010; Russell et al., 2011), which may partly be attributable to social camouflaging (Lai et al., 2016). If, as this study has found, girls with autism/high autistic trait have greater social reciprocity than boys on the autistic spectrum, despite similar levels of theory of mind, it is likely this is contributing to their under-recognition and/or late diagnosis. This proposition is particularly compelling given that deficits in social-emotional reciprocity are necessary to receive a clinical diagnosis.

2.4.1 Implications for Educational Psychology Practice

The broad aim of this research is to help identify individuals who may have social communication difficulties at an earlier age, to put in place early intervention, with the

goal of facilitating the best possible developmental outcomes. This is particularly important because late identification, as well as camouflaging, have been found to be associated with mental health difficulties in various groups, including autistic adults (Hull et al., 2017; Hull et al., 2019), late-diagnosed females (Bargiela et al., 2016) and autistic adolescents (Cridland et al., 2014; Tierney et al., 2016). At the same time, however, camouflaging has been found to have facilitated positive outcomes, such as success in jobs and relationships (Hull et al., 2019). It is therefore very important for practitioners to elicit the views and aspirations of individuals that may be engaging in camouflaging behaviours, as well as assess potential costs, as these may or may not be helping them to achieve important goals.

One important implication of these findings is that females with potential social communication difficulties may be missed by practitioners, particularly when only relying on observations of behaviour, which may limit the opportunities for them to receive interventions. These results suggest that practitioners should include measures beyond the behavioural domain when assessing children with potential social communication difficulties, such as measures of social cognition. Many of the females with autism/high autistic traits in this study had large discrepancies between their social cognitive and behavioural scores. Specifically, they often had relatively low theory of mind, but relatively high social reciprocity scores. As such, difficulties would have been picked up when including both measures, whereas many females would have appeared almost identical to neurotypical girls when only relying on the behavioural measure alone.

These results are in accordance with a growing body of literature suggesting that autism manifests differently in males than females. It is therefore important that the findings from this research is disseminated to stakeholders. For example, Educational Psychologists could include relevant sex/gender difference research in trainings for teaching staff. This is particularly important as school staff will often be the first to pick up difficulties in children before being referred to other professional services. A better understanding of the female autism phenotype in school staff may help facilitate early identification and intervention of girls with social communication difficulties in order to facilitate the beast possible outcomes. Finally, a better understanding of autism in general, and sex/gender differences in particular, may lead to a greater acceptance of differences in

society. For example, if society as a whole was more tolerant of the social idiosyncrasies that many individuals with autism display, then perhaps there would be less need for these individuals to engage in camouflaging behaviours.

2.4.2 Limitations and Future Research

As with any study, this one is not without its limitations. For example, participants with autism/high autistic traits had significantly lower verbal IQ than neurotypical participants. However, verbal IQ was included as a covariate in the analyses, and a significant group by gender interaction was found after controlling for the effects of age. The sample size was also modest, meaning it was underpowered to detect differences in IQ between those participants with autism/high autistic traits that engaged in high, versus low, levels of compensation. However, the a priori target number of participants was met, allowing significant interaction effects to be detected, the primary aim of this study.

Another limitation is that theory of mind scores were not significantly lower in the autism/high autistic traits, than neurotypical group. This might suggest that the task was not sensitive to theory of mind differences or, alternatively, both groups simply had similar theory of mind abilities. Theory of mind scores in our autism/high autistic traits group were slightly higher than diagnosed children (e.g., Brent, Rios, Happè, & Charman, 2004; Demurie, Corel, & Roeyers, 2011) and very similar to siblings of autistic children (Dorris, Espie, Knott, & Salt, 2004) in previous research; this would be expected considering our group included children without diagnoses, but with high autistic traits. However, a previous (unpublished) study found that the RMET-C was only able to differentiate between neurotypical and at-risk children when employing an open-ended format (Cassels, 2015), as opposed to forced-choice format, as used in this study. Future research should employ the RMET-C using an open-ended format, a wider range of theory of mind tasks – including more complex ones – as well as other social-cognitive tasks, to explore whether group or gender differences are found.

A strength of this study is that we included participants who had autistic traits who had not received a diagnosis. However, the majority had come to clinical attention (as the majority were under assessment for ASD). Arguably, those engaging in social camouflaging most successfully will not have come to clinical attention at all. As such, it would be useful for future research to include children with high autistic traits (e.g.,

broader autism phenotype) who were not known to clinical services. In addition, future research should include a sufficient number of participants to compare males and females with diagnoses to those with high autistic traits without a diagnosis, as well as neurotypical males and females. However, no significant differences were found on the main outcome measures between participants with a diagnosis and those with high levels of autistic traits, suggesting it was appropriate to incorporate them into the same group for the current study.

Autistic children in future studies should be asked to complete the IDT with another child, in order to maximise ecological validity. For example, it is possible that children may have a different behavioural presentation when interacting with peers, rather than a novel adult researcher. In addition, other measures, such as time taken to understand the IDT and level of imitation, should be taken, which may differentiate autistic girls who may be camouflaging from neurotypical girls. It would also be useful to directly compare behavioural tasks (such as the IDT), with observation-based measures, such as the Playground Observation of Peer Engagement (POPE), employed by Dean et al. (2016), as well as self-report measures of social camouflaging, such as the Camouflaging Autistic Traits Questionnaire (CAT-Q, Hull et al., 2019). This would help ascertain the extent to which behavioural tasks correspond to real-life social interaction, as well determine how successful individuals are in their intentions to camouflage. Finally, it is also very important for future research to try to disentangle the effects of sex and gender on camouflaging. For example, by including participants who and do not identify their gender with their biological sex.

2.4.3 Conclusion

In conclusion, this investigation of sex/gender differences in social reciprocity supports evidence of greater social camouflaging and compensation in girls than boys with autism/high autistic traits. To the researcher's knowledge, this is the first study to investigate camouflaging that has included participants with high autistic traits, without diagnoses. These results provide, at least in part, an explanation for why many girls with autism tend to be missed and diagnosed at a later age than their male counterparts.

Appendix A DSM-5 ASD Diagnostic Criteria

A. Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history (examples are illustrative, not exhaustive, see text):

1. Deficits in social-emotional reciprocity, ranging, for example, from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of interests, emotions, or affect; to failure to initiate or respond to social interactions.

2. Deficits in nonverbal communicative behaviors used for social interaction, ranging, for example, from poorly integrated verbal and nonverbal communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.

3. Deficits in developing, maintaining, and understanding relationships, ranging, for example, from difficulties adjusting behavior to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.

Specify current severity: Severity is based on social communication impairments and restricted repetitive patterns of behavior. (See table below.)

B. Restricted, repetitive patterns of behavior, interests, or activities, as manifested by at least two of the following, currently or by history (examples are illustrative, not exhaustive; see text):

1. Stereotyped or repetitive motor movements, use of objects, or speech (e.g., simple motor stereotypies, lining up toys or flipping objects, echolalia, idiosyncratic phrases).

2. Insistence on sameness, inflexible adherence to routines, or ritualized patterns or verbal nonverbal behavior (e.g., extreme distress at small changes, difficulties with transitions, rigid thinking patterns, greeting rituals, need to take same route or eat food every day).

Appendix B Search Strategy

Population	Comparator	Outcomes
autis* asd asc Asperger* ‘autism spectrum disorder’ ‘autism spectrum condition’	'sex difference*' 'sex-difference*' 'gender difference*' 'gender-difference*' ‘sex/gender difference*’ Sex/gender-difference*’	‘social interaction’ ‘social reciprocity’ ‘social-reciprocity’ ‘social-emotional reciprocity’ reciproc* conversation* imitat* ‘turn-taking’ ‘turn taking’ ‘eye contact’ ‘eye-contact’ ‘nonverbal communication’ ‘non-verbal communication’ friend* peer* gestur* ‘protodeclarative pointing’ ‘proto-declarative pointing’ point* socialisation socialization ‘joint attention’

Appendix C Appraisal of Cross-Sectional Studies (AXIS) checklist

	Question	Yes	No	Don't know/ Comment
Introduction				
1	Were the aims/objectives of the study clear?			
Methods				
2	Was the study design appropriate for the stated aim(s)?			
3	Was the sample size justified?			
4	Was the target/reference population clearly defined? (Is it clear who the research was about?)			
5	Was the sample frame taken from an appropriate population base so that it closely represented the target/reference population under investigation?			
6	Was the selection process likely to select subjects/participants that were representative of the target/reference population under investigation?			
7	Were measures undertaken to address and categorise non-responders?			
8	Were the risk factor and outcome variables measured appropriate to the aims of the study?			
9	Were the risk factor and outcome variables measured correctly using instruments/measurements that had been trialled, piloted or published previously?			
10	Is it clear what was used to determined statistical significance and/or precision estimates? (e.g. p-values, confidence intervals)			
11	Were the methods (including statistical methods) sufficiently described to enable them to be repeated?			
Results				
12	Were the basic data adequately described?			
13	Does the response rate raise concerns about non-response bias?			
14	If appropriate, was information about non-responders described?			
15	Were the results internally consistent?			
16	Were the results presented for all the analyses described in the methods?			
Discussion				
17	Were the authors' discussions and conclusions justified by the results?			
18	Were the limitations of the study discussed?			
Other				
19	Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?			
20	Was ethical approval or consent of participants attained?			

Appendix D AXIS Scores

Question Number:	1	2	3	4	5	6	7	8	9	10	11	12	13*	14	15	16	17	18	19*	20	Score
Baron-Cohen and Wheelwright (2005)	Y	Y	N	Y	DK	DK	N	Y	N/A	Y	Y	Y	DK	DK	Y	Y	Y	N	N	Y	12
Charwarska et al. (2016)	Y	Y	N	Y	DK	DK	N	Y	Y	Y	Y	Y	DK	DK	Y	Y	Y	N	N	Y	13
Cheng et al. (2017)	Y	Y	N	Y	DK	DK	N	Y	Y	Y	Y	Y	DK	DK	Y	Y	Y	N	N	Y	13
Dean et al. (2014)	Y	Y	N	Y	DK	DK	N	Y	Y	Y	Y	Y	DK	DK	Y	Y	Y	Y	N	Y	14
Dean et al. (2017)	Y	Y	N	Y	DK	DK	N	Y	Y	Y	Y	Y	DK	DK	Y	Y	Y	Y	N	Y	14
Harrop et al. (2018)	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	19
Harrop et al. (2017)	Y	Y	N	Y	DK	N	N	Y	Y	Y	Y	Y	DK	DK	Y	Y	Y	N	N	Y	13
Head et al. (2014)	Y	Y	N	Y	N	N	N	N	Y	Y	Y	Y	DK	DK	Y	Y	Y	Y	N	Y	13
Horiuchi et al. (2014)	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	DK	DK	Y	Y	Y	Y	N	Y	13
Knickmeyer et al. (2009)	Y	Y	N	Y	N	Y	N	N	Y	Y	Y	Y	DK	DK	Y	Y	Y	Y	N	Y	13
Parish-Morris et al., (2017)	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	DK	DK	Y	Y	Y	Y	N	Y	13
Sedgewick et al. (2016)	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	DK	DK	Y	Y	Y	Y	N	Y	13
Sedgewick et al. (2018)	Y	Y	N	Y	N	N	DK	Y	Y	Y	Y	Y	DK	DK	Y	Y	Y	Y	N	Y	13
van Ommeren et al. (2017)	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	DK	DK	Y	Y	Y	Y	N	Y	14

Appendix E SCDC Questionnaire

Checklist

For each item, please mark the box that best describes your child's behaviour over the past 6 months.

	Not true	Quite or sometimes true	Very or often true
1. Not aware of other people's feelings	☐	☐	☐
2. Does not realise when others are upset or angry	☐	☐	☐
3. Does not notice the effect of his/her behaviour on other members of the family	☐	☐	☐
4. Behaviour often disrupts family life	☐	☐	☐
5. Very demanding of other people's time	☐	☐	☐
6. Difficult to reason with when upset	☐	☐	☐
7. Does not seem to understand social skills, e.g. persistently interrupts conversations	☐	☐	☐
8. Does not pick up on body language	☐	☐	☐
9. Does not appear to understand how to behave when out (e.g. in shops, or other people's homes)	☐	☐	☐
10. Does not realise if s/he offends people with her/his behaviour	☐	☐	☐
11. Does not respond when told to do something	☐	☐	☐
12. Cannot follow a command unless it is carefully worded	☐	☐	☐

Do you have any other comments or concerns? (If yes, please describe.)

Appendix F Parent Information Sheet

Study Title: An Exploration of Gender Differences During Social Interaction in Children and Adolescents

Researcher: Henry Wood, Bonnie Wong

ERGO number: 32187

You are being invited to take part in the above research study. To help you decide whether you would like to take part or not, it is important that you understand why the research is being done and what it will involve. Please read the information below carefully and ask questions if anything is not clear or you would like more information before you decide to take part in this research. You may like to discuss it with others but it is up to you to decide whether or not to take part. If you are happy to participate you will be asked to sign a consent form.

What is the research about?

We are Trainee Educational Psychologists studying for the Doctorate in Educational Psychology at the University of Southampton.

We are interested in gender differences in social interaction in children and adolescents aged 8 – 13 years of age, including those young people who have a diagnosis of autism spectrum disorder (ASD). According to the American Psychiatric Association (APA), Autism spectrum disorder (ASD), also known as autism spectrum condition, is a neurodevelopmental syndrome characterised by 'persistent impairment in reciprocal social communication and social interaction, and restricted, repetitive patterns of behaviour, interests or activities'.

We want to explore the 'camouflaging' phenomenon, defined as a strategy that is suggested to be commonly used by girls diagnosed with ASD to "mask" difficulties in social interactions that can be experienced in young people with ASD.

Why have I been asked to participate?

You have been asked to participate because your child is aged between 8 and 13 years of age.

What will happen to me if I take part?

You will be asked to complete a questionnaire about your child(ren), which is attached alongside the consent form, consists of 12 items that consider autism traits in children and young people who do and do not have a diagnosis of ASD. In addition, we may ask you to complete a questionnaire that measures different social skills in your child, including e.g., communication, cooperation and empathy.

If you agree for your child to take part, they will come to a quiet room with the researcher in the school and will be asked to complete a pen and paper based task where they will asked to guess the emotional state (e.g., happy) of a picture of an individual when only the eye region is visible. They will also be asked to complete a test that measures their verbal ability and non-verbal ability and a drawing task with the researcher. Finally, they will be interviewed about the tasks they completed with the researcher, and asked to talk about a game or hobby they enjoy.

The drawing task and subsequent interview will be video recorded.

Are there any benefits in my taking part?

Your participation will help develop our understanding of the social challenges in ASD. We hope that this project will help to identify aspects of social situations that young people diagnosed with ASD find difficult.

As a thank you for your valuable contribution and time, we are able to offer you a £5 voucher for participation. Additionally, we are able to offer you an opportunity to attend a workshop on Autism led by us.

Will my participation be confidential?

Your participation and the information we collect about you during the course of the research will be kept strictly confidential.

Only members of the research team and responsible members of the University of Southampton may be given access to data about you for monitoring purposes and/or to carry out an audit of the study to ensure that the research is complying with applicable regulations. Individuals from regulatory authorities (people who check that we are carrying out the study correctly) may require access to your data. All of these people have a duty to keep your information, as a research participant, strictly confidential.

All of the data we collect as part of this project will be pseudonymised and treated confidentially. Only the research team has access to such data. All participants will be assigned a number, which will be used for data analysis. A spreadsheet that links the participants' names to the number will be kept on a password protected memory stick that only the researchers have access to. Voluntary Research Assistant (VRAs) are used to assist with transcription of the interview data in an anonymised format. They have signed a confidentiality agreement in order to protect participants' data.

This will allow the researchers to delete participants' data after the experiment has taken place if requested. Consent forms will be stored in a locked cabinet at one of the researchers' house and destroyed one year after data collection. All data will be stored in line with the Data Protection Act (2018).

Do I have to take part?

No, it is entirely up to you to decide whether or not to take part. If you decide you want to take part, you will need to sign a consent form to show you have agreed to take part.

What happens if I change my mind?

You have the right to change your mind and withdraw at any time without giving a reason and without your participant rights being affected, up to the point of data analysis. If you withdraw, your data will be destroyed.

What will happen to the results of the research?

Your personal details will remain strictly confidential. Research findings made available in any reports or publications will not include information that can directly identify you without your specific consent.

The results of the research will be written up as part of our theses, which may be published in the future (e.g. academic journals). A copy of the results will be available upon request. The research data will be stored for a minimum of 10 years, as per University of Southampton policy.

Where can I get more information?

If you have any further questions please contact Henry Wood at hwd1n15@soton.ac.uk or Bonnie Wong at b.wong@soton.ac.uk

What happens if there is a problem?

If you have a concern about any aspect of this study, you should speak to the researchers (Henry Wood at hwd1n15@soton.ac.uk or Bonnie Wong at b.wong@soton.ac.uk) who will do their best to answer your questions.

If you remain unhappy or have a complaint about any aspect of this study, please contact the University of Southampton Research Integrity and Governance Manager (023 8059 5058, rgoinfo@soton.ac.uk).

Data Protection Privacy Notice

The University of Southampton conducts research to the highest standards of research integrity. As a publicly-funded organisation, the University has to ensure that it is in the public interest when we use personally-identifiable information about people who have agreed to take part in research. This means that when you agree to take part in a research study, we will use information about you in the ways needed, and for the purposes specified, to conduct and complete the research project. Under data protection law, 'Personal data' means any information that relates to and is capable of identifying a living individual. The University's data protection policy governing the use of personal data by the University can be found on its website (https://www.southampton.ac.uk/legalservices/what-we-do/data-protection-and-foi.page).

This Participant Information Sheet tells you what data will be collected for this project and whether this includes any personal data. Please ask the research team if you have any questions or are unclear what data is being collected about you.

Our privacy notice for research participants provides more information on how the University of Southampton collects and uses your personal data when you take part in one of our research projects and can be found at http://www.southampton.ac.uk/assets/sharepoint/intranet/ls/Public/Research%20and%20Integrity%20Privacy%20Notice/Privacy%20Notice%20for%20Research%20Participants.pdf

Any personal data we collect in this study will be used only for the purposes of carrying out our research and will be handled according to the University's policies in line with data protection law. If any personal data is used from which you can be identified directly, it will not be disclosed to anyone else without your consent unless the University of Southampton is required by law to disclose it.

Data protection law requires us to have a valid legal reason ('lawful basis') to process and use your Personal data. The lawful basis for processing personal information in this research study is for the performance of a task carried out in the public interest. Personal data collected for research will not be used for any other purpose.

For the purposes of data protection law, the University of Southampton is the 'Data Controller' for this study, which means that we are responsible for looking after your information and using it properly. The University of Southampton will keep identifiable information about you for 10 years after the study has finished after which time any link between you and your information will be removed.

To safeguard your rights, we will use the minimum personal data necessary to achieve our research study objectives. Your data protection rights – such as to access, change, or transfer such information - may be limited, however, in order for the research output to be reliable and accurate. The University will not do anything with your personal data that you would not reasonably expect.

If you have any questions about how your personal data is used, or wish to exercise any of your rights, please consult the University's data protection webpage (https://www.southampton.ac.uk/legalservices/what-we-do/data-protection-and-foi.page) where you can make a request using our online form. If you need further assistance, please contact the University's Data Protection Officer (data.protection@soton.ac.uk).

Thank you for taking the time to read the information sheet and considering taking part in the research

Appendix G Parent Consent Form

UNIVERSITY OF Southampton

CONSENT FORM

Study title: An Exploration of Gender Differences During Social Interaction in Children and Adolescents

Researcher name: Henry Wood, Bonnie Wong
ERGO number: 32187
Participant Identification Number:

Please initial the box(es) if you agree with the statement(s):

I have read and understood the information sheet (4th March, 2019, Version 5) and have had the opportunity to ask questions about the study.	
I agree to take part in this research project and agree for my data to be used for the purpose of this study.	
I understand my participation is voluntary and I may withdraw until the point of data analysis for any reason without my participation rights being affected.	
I understand my child's participation is voluntary and he/she may withdraw up until the point of data analysis for any reason without his/her rights being affected.	
I understand that my child will be video recorded whilst completing a drawing task and the subsequent interview.	
I understand that the information collected about my child may be anonymised and used in future ethically approved research studies.	
I understand that information collected about me during my participation in this study will be stored on a password protected computer and that this information will only be used for the purpose of ethically approved research studies.	

Name of participant (print name).....

Signature of participant.....

Date.....

Name of researcher (print name)...BONNIE WONG AND HENRY WOOD.....

Signature of researcher .....

Date.....

[4th March 2019] [Version Number 4] [Ethics/IRAS reference 32187]

Appendix H Child Information Sheet

UNIVERSITY OF Southampton

Invite for participation – Child/Young person

Hello,

We are researchers from the University of Southampton.

We are interested in how children socialise and make friends. Your parents and/or Head Teacher have said they are happy for you to take part in our study. However, we need to make sure you are happy to take part. If you are not, then you can stop at any time.

If you agree to take part, we will complete some questionnaires with you, as well as complete a drawing task with you. We will then ask you some questions about what you have done. The whole process will take around 45 minutes. If you need a break, then just let us know.

Although this is going to be recorded on the video camera, everything you do will be confidential. You can choose not to take part, but if you do it will help us to understand how children socialise and make friends.

Henry and Bonnie

Appendix I Child Consent Form

UNIVERSITY OF Southampton

INITIAL CONSENT FORM – Child/Young person

Dear Henry and Bonnie

I have read, or been read, the information letter which explains the research that you would like to do. I understand what you would like me to do and am happy to continue. I understand that I can stop at any time.

My details are:

Name:

Name of school:

Signature: Date:

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