Understanding and Recognising the Female Phenotype of Autism Spectrum Disorder and the "Camouflage" Hypothesis: A Systematic PRISMA Review

Dr Clare S Allely, Reader in Forensic Psychology, School of Health Sciences, University of Salford, Manchester, England and affiliate member of the Gillberg Neuropsychiatry Centre, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden.

Dr Clare Allely is a Reader in Forensic Psychology at the University of Salford in Manchester, England and is an affiliate member of the Gillberg Neuropsychiatry Centre at Gothenburg University, Sweden. Clare holds a PhD in Psychology from the University of Manchester and has previously graduated with an MA (hons.) in Psychology from the University of Glasgow, an MRes in Psychological Research Methods from the University of Strathclyde and an MSc in Forensic Psychology from Glasgow Caledonian University. Clare is also an Honorary Research Fellow in the College of Medical, Veterinary and Life Sciences affiliated to the Institute of Health and Wellbeing at the University of Glasgow. Clare's primary research projects and interests include the pathway to intended violence in mass shooters; serial homicide and autism spectrum disorders in the criminal justice system.

Abstract

Purpose: Females with ASD may display superficial social skills which may mask their autism spectrum disorder (ASD) symptomology impacting on the identification of the disorder – known as the "camouflage" hypothesis. Compared to males with ASD, it is increasingly recognised that females with ASD have a stronger ability to imitate behaviour which is socially acceptable, particularly those females who have higher cognitive abilities (i.e., intelligence considered to be within the normal range) (Ehlers & Gillberg, 1993).

Design/methodology/approach: This present paper will explore the literature on camouflaging or masking behaviour in females with ASD. A systematic PRISMA review was conducted.

Findings: The capacity to 'camouflage' social difficulties in social situations is considered to be one of the main features of the female phenotype of ASD (e.g., Kenyon 2014). Social imitation or camouflaging enables some level of success and coping which results in some females never receiving a diagnosis of ASD. They typically may not exhibit any observable functional impairments. However, under the surface of the camouflage, females may experience high levels of subjective stress, anxiety and exhaustion and a need to re-charge or recuperate by withdrawing from any social interaction.

Practical implications: There is a need for the development of a camouflaging measure.

Research limitations/implications: There is a relatively little understanding and knowledge of the female phenotype of ASD. This lack of understanding and knowledge impacts significantly on the ability to identify females with ASD (Lai et al., 2015; Bargiela et al., 2016) which can have a number of negative consequence (Adamou et al., 2018; NICE, 2012).

Originality/value: There is a real need for further research exploring the positive and negative impact of the phenomenon of 'camouflaging', or 'pretending to be normal' in females with ASD.

Keywords: Autism spectrum disorder; autism; females; women; girls; diagnosis; gender; masking; camouflage; imitation

Autism spectrum disorder (ASD) is a neurodevelopmental condition characterised by social communication and social interaction difficulties as well as restricted, repetitive behaviours or interests (RBRIs) (American Psychiatric Association, APA, 2013). In the Diagnostic and Statistical Manual of Mental Disorders (DSM–5, APA, 2013) the subtypes of ASD have been removed (e.g., autistic disorder and Asperger disorder) and there is now just a single category of ASD (Maenner et al., 2014). Studies which have used non-referred samples has found that there are between two and three males with ASD for each female (e.g., Constantino et al., 2010; Kim et al., 2011; Zwaigenbaum et al., 2012).

Studies have indicated that ASD is identified in males at a much higher frequency compared to females (Brugha et al., 2011; Kim et al., 2011). Approximately four males are diagnosed with ASD for every female (e.g., Fombonne 2009; Szatmari, Chawarska, Dawson, Georgiades, Landa et al., 2016; Lord, Rutter, & Le Couteur, 1994; Volkmar, Szatmari, & Sparrow, 1993; McLennan, Lord, & Schopler, 1993; Brugha, McManus, Bankart, Scott, Purdon et al., 2011; Loomes, Hull, & Mandy, 2017). Possible explanations for this male-to-female ratio have yet to be fully understood (Adamou, Johnson, & Alty, 2018). Kirkovski and colleagues (2013) have previously highlighted that, when looking across the spectrum, this observed gender ratio is not distributed evenly.

There have been a number of studies which have found that as the symptom severity of ASD increases, the sex ratio appears to decrease (e.g., Werling & Geschwind, 2013). As previously raised by Kirkovski and colleagues (2013), a number of epidemiological studies have found that the ratio becomes about 2:1 towards the lower-functioning end of the autism spectrum (which also consists of those individuals with a comorbid intellectual disability, ID) (Fombonne, 2003, 2009; Mattila et al., 2011). In studies looking at the high-functioning end of the spectrum (consisting of individuals who are within the normal range of intellectual functioning), it has been found that the gender ratio may increase to about 6:1 (Fombonne, 1999) (Kirkovski, Enticott, & Fitzgerald, 2013). There is an increasing number of studies highlighting that, compared for males, females with ASD have a tendency to be receive a diagnosis of ASD much later (e.g., Rivet & Matson, 2011). It is clear that there is a need for more epidemiological studies in this area to elucidate how the ratio varies across the spectrum controlling for a variety of potentially confounding factors.

Males and females may require partly different criteria in defining "having" ASD

In order to fulfil the diagnostic criteria for ASD females require a greater severity of ASD symptomology (Russell et al., 2010) and more significant cognitive and behavioural issues (Dworzynski et al., 2012) than males. Moreover, in female pupils teachers tend to underreport autistic traits (Posserud et al., 2006). The detrimental implications of such gender bias has been highlighted as an area which needs urgent research attention (Pellicano et al., 2014 as cited in Bargiela et al., 2016).

It has been argued that the current diagnostic criteria for ASD is not sensitive to (or does not capture) the qualitative differences in the ASD symptomology between males and females (Gould & Ashton-Smith, 2011), the quantitative differences in the normative distribution of ASD traits between males and females (Constantino & Charman, 2012; Lai, Lombardo, Chakrabarti, & Baron-Cohen, 2013) and developmental differences between males and females with ASD (Lai et al., 2011, Kreiser & White, 2014). This strongly supports the notion that there is to some degree different criteria in defining "having" ASD between males and females. For instance, females have a tendency to display more developed social skills or appear better adapted compared to their male counterparts with ASD (Dworzynski, Ronald, Bolton, & Happé, 2012; Wang et al., 2017, Head, McGillivray, & Stokes, 2014). As a result, during the diagnostic assessment (if they even seek a diagnosis in the first place), females with ASD may not appear that impaired (Dworzynski, Ronald, Bolton, & Happé, 2012) resulting in a rate of diagnosis which is lower than that found in males. Moreover, studies have suggested that clinicians are less likely to identify the Repetitive Behaviours and Restricted Interests (RBRIs) in females as they tend not to be the typical repetitive behaviours commonly associated with ASD (see Allely, under review).

Despite the emergence of these findings in the literature, field trial publications outlined in the DSM-5 do not refer to any sex differences in the ASD diagnostic criteria between the DSM-5 and the earlier version, the DSM-IV. Nevertheless, evidence has indicated that females are identified no better or worse using the DSM-5 when compared to the DSM-IV (e.g., Huerta et al., 2012; McPartland et al., 2012; Haney, 2016). When used correctly, some have argued that there is no sex biases with current diagnostic tools (Murray, Allison, Smith, Baron-Cohen, Booth, & Auyeung, 2017). However, there have been some findings which appear to contradict these studies. For instance, Hiller and colleagues (2014) published a paper which stated that in females there were more inconsistencies in fulfilling the diagnostic criteria in the DSM-5 after previous diagnosis based on the DSM-IV compared to males (Hiller, Young, & Weber, 2014). In a recent paper, Haney (2016) did point out that even though there is no guidance on gender bias issues in the DSM-5 it does state that females with ASD may not receive a diagnosis of ASD as a result of gender differences. It goes on to make to make the

following statement: *"girls without accompanying intellectual impairments or language delays may go unrecognized, perhaps because of subtler manifestations of social and communication difficulties"* (APA, 2013, pp. 57).

'Culture-based interpretations of behaviour' is another factor which may be detrimental to identifying females with ASD (Kreiser & White, 2014). A female with ASD who displays unusual or peculiar behaviour or social difficulties may be considered as being ''shy,'' ''passive,'' or ''immature'' as opposed to rather than socially impaired or developmentally delayed, Such gender-based expectations can be even more marked if the female with ASD appears to be ''getting by'' or ''coping reasonably well'' (Attwood 2006 as cited in Kreiser & White, 2014).

It is also important to highlight that co-morbid intellectual disability is more likely to be found in females with ASD compared to males with ASD (e.g., Rubenstein, Wiggins, & Lee, 2015). Moreover, sensory issues, seizures, sleep disturbances, anxiety and depression are also found to be more prevalent in females with ASD compared to males with the same disorder (Lai, Lombardo, Pasco et al., 2011; Giarelli, Wiggins, Rice, Levy, Kirby, Pinto-Martin, & Mandell, 2010; Solomon, Miller, Taylor, Hinshaw, & Carter, 2012; May, Cornish, & Rinehart, 2014; Hartley, & Sikora, 2009). It has been suggested that a potential explanation for the higher prevalence of comorbid intellectual disability in females with ASD compared to males with ASD is the lack of sensitivity of current ASD diagnostic criteria to females with intellectual functioning which is within the normal range (Haney, 2016, see also Ratto et al., 2018). Lastly, based on a community-based sample, Mussey and colleagues (2017) studied the gender differences in age of diagnosis, cognitive profiles, social communication symptomatology and ASD symptom severity. The sample comprised of 566 males and 113 females with ASD (age range: one year, nine months to 56 years, four months). Findings revealed very small or no gender differences in the age in which a diagnosis was received, intelligence quotient, cognitive profiles or severity of ASD symptomology. This is inconsistent with the belief that a lower intelligence quotient (IQ) and greater severity of ASD symptoms is more likely to be found in females with ASD (Mussey, Ginn, & Klinger, 2017).

In sum, diagnosis with a co-occurring disorder can result in ASD being unidentified in females (see Kreiser & White, 2014 for review). Females with ASD who also exhibit other comorbidities (e.g., low intellectual functioning, behavioural difficulties) tend to be the ones who are diagnosed early (Dworzynski et al. 2012). Females who receive a late diagnosis may have felt different to others all their lives and never felt like they "fit in", until their own children were diagnosed with ASD and they saw parallels to themselves (Holliday Willey, 2015; Hull, Petrides, Allison, Smith, Baron-Cohen, Lai, & Mandy, 2017).

The "camouflage" hypothesis

Females with ASD may display superficial social skills which may mask their ASD symptomology impacting on the identification of the disorder – known as the "camouflage" hypothesis (Hull et al., 2017). Compared to males with ASD, it is increasingly recognised that females with ASD have a stronger ability to imitate behaviour which is socially acceptable, particularly those females who have higher cognitive abilities (i.e., intelligence considered to be within the normal range) (Ehlers & Gillberg, 1993; Gillberg, 1993; Attwood, 2006; Mattila et al., 2007; Goldman, 2013; Haney, 2016). Attwood (2006) found that girls can be quite effective at providing themselves with "a superficial social competence" (pp. 4) by imitating and modelling the mannerisms, voice and personality of individuals who are socially skilled.

Present Study

One of the primary aims of this paper is to identify and explore the literature on camouflaging or masking behaviour in females with ASD. There is a relatively little understanding and knowledge of the female phenotype of ASD. This lack of understanding and knowledge impacts significantly on the ability to identify females with ASD (Lai et al., 2015; Bargiela et al., 2016) which can have a number of negative consequence (Adamou et al., 2018; NICE, 2012). As stated previously by Lai and colleagues (2017), the present review operationalises camouflaging as "the discrepancy between the person's 'external' behavioural presentation in social–interpersonal contexts and the person's 'internal' status (i.e. dispositional traits and/or social cognitive capability)" (Lai et al., 2017, pp. 699). The term masking is used to characterise aspects of camouflaging which involve an individual hiding the features of their ASD. Some of the typical ways of hiding features of ASD involve developing different personas or characters to use during social situations (Hull et al., 2017). This paper will also discuss clinical implications and recommendations and also explore some future research directions.
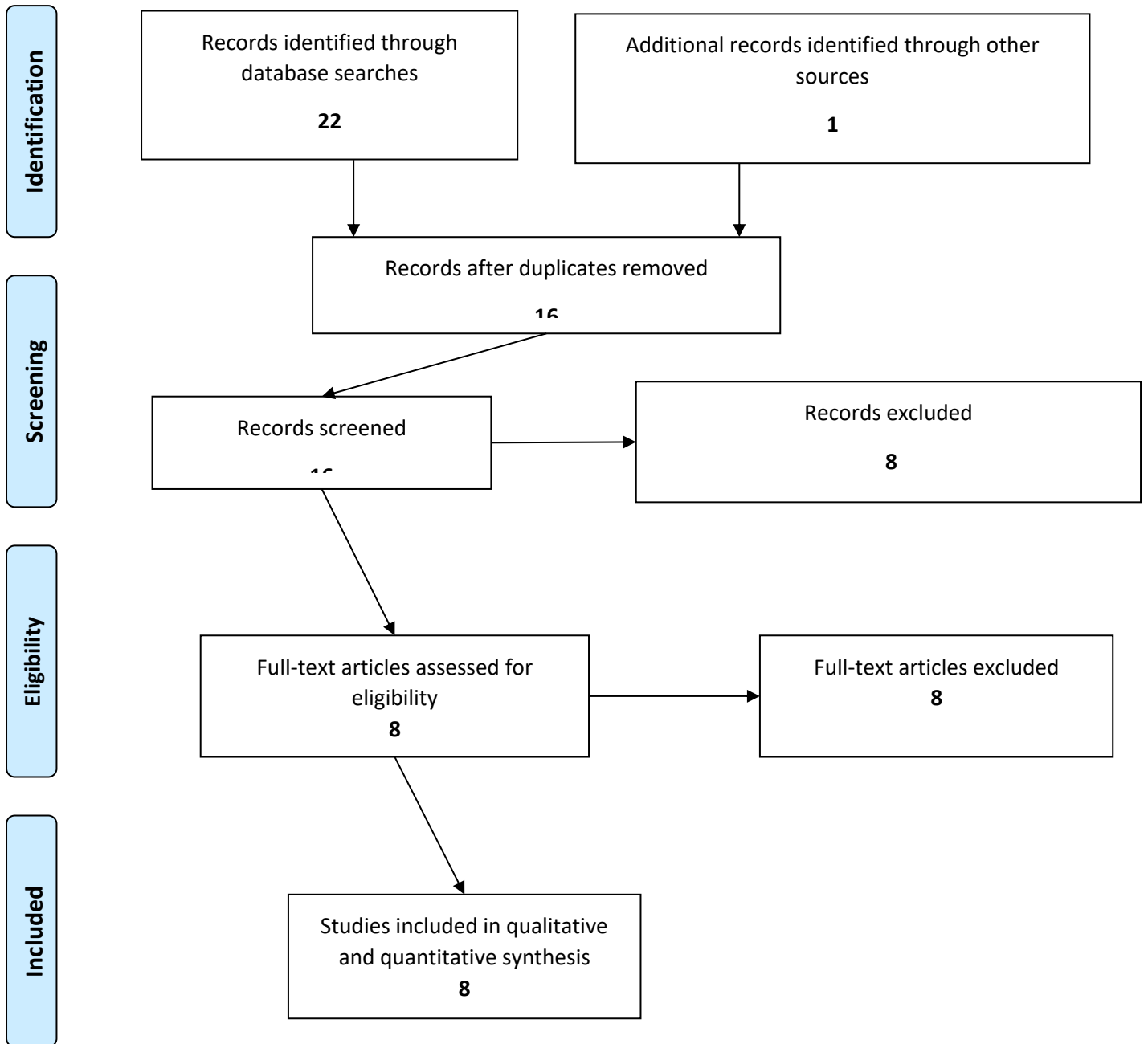
Method

A total of five internet-based bibliographic databases were searched in order to identify studies which empirically investigated camouflaging or masking behaviour in females with ASD. Specifically, PsycARTICLES Full Text; AMED (Allied and Complementary Medicine) 1985 to October 2018; PsycEXTRA 1908 to October 08, 2018; PsycINFO 2002 to October Week 4 2018 and also Ovid

MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily 1946 to October 23, 2018. The search on the five databases was conducted on 26th October 2018. The search followed PRISMA guidelines (see: Liberati et al., 2009; Moher, Liberati, Tetzlaff, & Altman, 2009). The search was not restricted by date. Search terms were applied to title. The following search criteria were entered into the five databases: (ASD or "autis* spectrum disorder*" or autis* or "autis* spectrum condition*" or asperger*).m_titl. AND ("superficial social*" or camouflag* or mask* or "peer-imitation" or "peer imitation").m_titl.

This search returned 22 articles. Following the removal of duplications there were 15 articles. One of the 15 articles was an editorial letter and not included. Eight articles were not relevant. This resulted in only seven articles which were found to be relevant. As well as the searches carried out on the five database listed above, numerous permutations of ASD and camouflaging behaviour were entered into Google Scholar and thoroughly searched for articles which were not identified through the database searches, for instance, ASD and camouflage; Autism and camouflage; autism and social masking; autism and peer-imitation, etc. This resulted in one further study which was identified as being relevant to the present review (see Figure 1. For PRISMA Flow Diagram of this process). Lastly, given the relatively lack of research in this area, the present systematic review adopted an inclusive approach. There were no exclusion criteria for the studies identified which empirically investigated camouflaging or masking behaviour in females with ASD.

Figure 1. PRISMA Flow Diagram

Identification	Records identified through database searches **22**
	Additional records identified through other sources **1**

Records after duplicates removed

16

Screening

Records screened

16

Records excluded

8

Eligibility

Full-text articles assessed for eligibility
8

Full-text articles excluded
8

Included

Studies included in qualitative and quantitative synthesis
8

Results

A total of eight articles were identified in the present review. Four studies involved semi-structured interviews with girls and women with ASD (Bargiela et al., 2016; Tierney et al., 2016; Hull et al., 2017; Cook et al., 2018), two studies were quantitative, utilising standardised measures and assessments (Rynkiewicz et al., 2016; Parish-Morris et al., 2017); one study used behavioural and cognitive measures as well as neuroimaging (Lai et al., 2017) and lastly, one study used concurrent mixed methods (quantitative and qualitative simultaneously) (Dean et al., 2017). (See Table 1. for details of studies included in the review).

[Table 1 about here].

Qualitative literature exploring the experiences of females with ASD

There is a paucity of qualitative literature exploring the experiences of females with ASD (Kanfiszer, Davies, & Collins, 2017). Only four studies were identified in the present review which investigated camouflaging behaviours in females with ASD. All four of the qualitative studies involving semi-structured interviews found evidence of camouflaging and/or masking behaviour in their sample (Bargiela et al., 2016; Tierney et al., 2016; Hull et al., 2017; Cook et al., 2018). For instance, in the study by Hull and colleagues (2017), respondents reported that they would engage in camouflaging behaviours so that they would 'blend in with the normals' or seem 'normal enough'. Another main motivation for respondents reported for engaging in camouflaging was to increase their connections and relationships with other people. Camouflaging enabled them to overcome the initial difficulties to connection and allowed for the development of relationships. Many of the respondents in the study had developed explicit strategies in order to address their social and communication difficulties associated with their ASD. In their paper, Hull and colleagues referred to these explicit strategies as compensation. Some examples of these explicit, compensatory strategies employed to improve non-verbal communication with others included forcing and maintaining appropriate eye contact or trying to look as close to another person's eyes as possible. The respondents in the study reported how engaging in these compensatory strategies required them to monitoring intensively the way that they acted. This intensive self-monitoring would help them ensure that they were performing them as close as possible to what they considered normal. Respondents also reported making a conscious effort to present to others facial expressions of emotion or interest even if these facial expressions of emotion

or interest did not match what they felt inside. A mental list of how to behave depending on the situation was another strategy employed by many of the respondents. Another interesting finding was that many of the respondents described over-emphasising their emotional expression and body language (involving both non-verbal and verbal signs of interest in the social interaction) in order to try and communicate more effectively with others because the levels of emotional expression and body language that they preferred was different to others. This strategy was also employed to encourage others to continue talking with the aim of taking the pressure off in trying respond in an appropriate way. Taking time prior to an interaction in order to prepare topics of conversation was another strategy reported by respondents (e.g., questions to ask) which would ensure they that structured 'scripts' rather than having to engage in spontaneous 'chat' (Hull et al., 2017).

The four studies here also found that there were negative consequences as a result of engaging in camouflaging behaviours. For instance, Hull and colleagues (2017) found that exhaustion was the most consistent consequence of engaging in camouflaging. Specifically, respondents commonly reported camouflaging as being "mentally, physically, and emotionally draining; requiring intensive concentration, self-control, and management of discomfort" (Hull et al., 2017, pp. 2527). Maintaining the intended level of camouflaging became increasingly difficult the longer that they had to engage in the camouflaging behaviour. Time needed to recover following a camouflaging session was reported by many of the respondents. The recovery time would typically involve being alone where they could 'release all of the behaviours they had been suppressing' (Hull et al., 2017, pp. 2527). Some of the respondents also described experiencing severe levels of anxiety and stress, in addition to exhaustion, following a session of camouflaging. Lastly, respondents also felt that camouflaging affected the perception they had of themselves. Specifically, their sense of authenticity and also how they represented themselves to the outside world. By camouflaging their 'true' behaviours, many respondents felt that they were lying about who they really were which was something that was frequently regretted. The respondents wanted to be happy as they were (their 'true' selves) but the pressures of the typical social world made this impossible (Hull et al., 2017).

Consistent with the study by Hull and colleagues (2017), Cook and colleagues (2018) also found in their sample of 11 girls with ASD (aged between 11–17 years) and one parent of each girl that masking could sometimes address the issue of their social impairment. There are occasions where issues may arise due to the engagement in camouflaging or masking behaviours. Some of the girls when adapting their behaviour would frequently experience difficulties as a result of the limitations in their social skills. Cook and colleagues suggest that it is possible that the tendency to camouflage their deficits subsequently resulted in the development of the 'internalisation of problems' which has previously been shown to result in even higher levels of stress and anxiety (Cook, Ogden, & Winstone,

2018). A number of participants in the study by Bargiela and colleagues (2016) also reported efforts to camouflage. Participants reported deliberately making an effort to learn and employ 'neurotypical' social skills which they sometimes referred to as 'putting on a mask'. Bargiela and colleagues findings indicate that the development of such neurotypical personas may depend on a number of things including: close observation of peers, trial and error social learning, reading novels and psychology books and imitating fictional characters. Bargiela and colleagues (2016) also found that there were some aspects of camouflaging that were unconscious which requires further investigation. For instance, some women described copying the social behaviour of other people around with no conscious awareness that they were engaging in social mimicking (Bargiela et al., 2016).

Lastly, Tierney and colleagues (2016) interviewed 10 teenage girls with ASD on the social challenges they experience relating to adolescence (Tierney, Burns, & Kilbey, 2016). The teenage girls with ASD reported developing explicit sophisticated strategies (which drew from innate strengths) in order to manage social relationships and helped them to seem competent socially to observers. Some of the explicit strategies used to ensure that the core areas of impairment in ASD were not identified by others included imitation and masking. Specifically, the activities of imitation and acting were found to be reported in most of the interviews. Six of the participants attended drama classes and reported taking part in these classes had improved their confidence and also their skills in social situations. The engaging in sophisticated levels of peer-imitation were reported by the participants. For instance, pretending to be engaged with an activity (such as reading a book). However, what they would be doing was observing others to help them imitate their behaviour, facial expressions, etc. Tierney and colleagues (2016) found that participants were motivated to do this in order to blend in with other people (their peers, for example) and not appear to be significantly different. Some of the things that would be imitated were facial expressions, postures, tone of voice, conversation topics and choice of interests. Participants were fearful of being 'caught out' and so would go to significant lengths in an attempt to conceal their imitative behaviours. For instance, one of their participants, Gemma, reported:

"I would try and copy them but not look like I was exactly copying them, so if they were playing a game and they moved and they did something then I would try and copy it but not exactly like them" (Tierney et al., 2016, pp. 79).

Additionally, all ten participants in Tierney and colleague's study reported that in social situations they felt unhappy and anxious. They would, in the majority of social environments, mask their true feelings by having a facial expression which was 'excessively happy' or, alternately, a facial expression which was blank. This mask was still adopted even after making friends for fear of losing

the friendship should their friends see what they are really feeling inside. For instance, they highlight a comment made by one of their participants, Nadia: *"I do hide many of my emotions and I'm used to like having a smile on my face"* (Tierney et al., 2016, pp. 79). Crucially, Tierney and colleagues (2016) emphasised in their paper that the participants reported that the frequent use of "highly sophisticated imitation and demanding masking strategies" would results in a number of negative consequences (pp. 79). For instance, when the participants exceeded "their threshold to maintain their efforts" there was emotional consequences (pp. 79). This is clearly illustrated by the following exchange between the interviewer and one of the participants:

"Interviewer: *Do you think it takes a lot of effort from you to be like a chameleon?*

Gemma: *Yes, it's very hard and when I came home from my primary school I was very exhausted and tired cos I'd acted so much*" (Tierney et al., 2016, pp. 79).

Moreover, Tierney and colleagues also found that some participants described a stark contrast between their social-persona and how they interacted with family, where they felt they could be their 'true selves'. This strategy of imitating superficial social skills has previously been reported (e.g., Kopp & Gillberg, 1992).

Quantitative studies utilising standardised measures and assessments

Two studies were quantitative, utilising standardised measures and assessments (Rynkiewicz et al., 2016; Parish-Morris et al., 2017). Parish-Morris and colleagues (2017) investigated a new type of camouflage based on differences found in language. Pauses during conversation can be filled with words like UM or UH. They found that girls used UH less often compared to boys across both diagnostic groups (ASD and typically developing). Suppression of UH was found to result in higher UM ratios for the girls compared to the boys. Additionally, it was found that, compared to the children with ASD, filled pause rates were higher for typically developing children. Higher UM ratios were also found to be correlated with better socialisation in boys with ASD. However, this effect was driven by greater utilisation of UH by the boys who exhibited more ASD symptoms. One of the possible explanations that Parish-Morris and colleagues provide in order to explain why girls with ASD (despite having similar social communication impairments to boys with ASD) fill conversational pauses with "typical-sounding" words and suppress atypical words like UH is that girls are not using the filled pauses as communicative tools. Instead, they are producing higher UM ratios (and lower rates of UH) as a form of unconscious social mimicry. For instance, a girl with ASD may produce typical UM ratios in order to appear more typical and increase the chances of effective integration with others in social situations.

However, one of the difficulties with this is that the girl with ASD who adopts these camouflaging techniques may not fully understand and appreciate the social meaning behind the different types of filled pauses, and have significant difficulties with social communication similar to that experienced by the boys with ASD that do not engage in any "normalisation" their UM ratios. Lastly, compared to the boys with ASD, girls with ASD produced higher UM ratios as a result of suppressing the word UH. However, the girls with ASD overall filled pause rate was still below that displayed in the typical participants resulting in a camouflaging strategy which was incomplete (Parish-Morris et al., 2017).

The study by Rynkiewicz and colleagues (2016) was included in the present review because it was a quantitative study which found sex differences in the use of gestures. It was not specifically examining and probing into whether the participants had engaged in these behaviours (either consciously or unconsciously) in order to try and camouflage or mask their social impairments. Given the lack of studies in this area it was decided that it would be potentially useful to include this paper which may help inform future research in the area of camouflaging behaviour and ASD. Three key aspects were examined while the gestures were recorded during two demonstration activities of ADOS-2 sessions: motor activity when demonstrating the toothbrushing skill under the Demonstration Task. Also, motor activity when re-telling the story under the Cartoons and motor activity of both activities added together. The three key aspects included: (1) attention to the length by which the respective body parts (each point individually out of 10 points representing the body parts mentioned above) were moved in gesturing, (2) the time a child spent performing the task and (2) the Gesture Index which is the length to time ratio of the above. Overall, findings, based on the Gesture Index, revealed that girls with ASD had a tendency to use gestures more vividly compared to the boys with ASD. Rynkiewicz and colleagues (2016) use the term "vivid" to characterise gestures that are longer gestures but are presented in shorter time (higher Gesture Index for girls with ASD than Gesture Index for boys with ASD). Given this, there is the possibility that these "vivid" gestures may go unidentified by a human observer as gestures with increased energy (Rynkiewicz et al., 2016).

Concurrent mixed methods

One study used concurrent mixed methods (quantitative and qualitative simultaneously) (Dean et al., 2017). Consistent with the camouflage hypothesis, Dean and colleagues (2017) found that girls with ASD adopted compensatory behaviours (including remaining close in proximity to peers) which masked their social difficulties. They suggested that such compensatory behaviours may be one of the reasons why ASD is less easy to detect in females with ASD compared to males. The girls with ASD looked similar to the typically developing (TD) girls when observed from a distance. The girls with

ASD exhibited a tendency to flit in between Joint Engage and Solitary while the TD girls maintained their Joint Engage status while moving between groups. These findings would indicate that although the social challenges exhibited by the girls with ASD were hidden from the playground attendants, they may not be hidden from their peers (Dean, Harwood, & Kasari, 2017).

Behavioural and cognitive measures as well as neuroimaging

One study used behavioural and cognitive measures as well as neuroimaging (Lai et al., 2017). Lai and colleagues (2017) this study provides the first attempt to operationalise and quantify camouflaging in men and women with ASD. Findings revealed significant inter-individual variability but on-average higher levels of camouflaging in women compared to the men. It also demonstrates potentially sex/gender-dependent associations with depressive symptoms, signal-detection sensitivity and regional brain volume. The positive association with depressive symptoms (as predicted) in men raises the possibility that they are more susceptible to the burden of camouflaging compared to women with ASD. One potential explanation for this may be that the women with ASD had more experienced and successful with implementing camouflaging strategies as a result of gender-related social experience and demands. There is a need for further investigation of the causal relationships between stress, anxiety/depression, cognitive features, camouflaging and social adaptation, using either structural equation modelling for cross-sectional data or longitudinal designs. Furthermore, Lai and colleagues did not find a significant correlation between verbal ability and camouflaging in either men or women with ASD. This suggests that the extent of camouflaging does not merely reflect verbal knowledge or reasoning; rather, it might be associated with verbal skills beyond these or might be underpinned by other cognitive capabilities. (Lai et al., 2017).

Lai and colleagues advocate the need for further study into this clinically important phenomenon to further our understanding and knowledge. Specifically they suggest that the following areas require further investigation: "(1) qualitative (or mixed-design) approaches to reveal first-person account and second/third-person observation about what triggers (e.g. when and why one camouflages) and constitutes camouflaging (e.g. what the behavioural components are, and which of them are automatic/intuitive vs requiring one to act/perform with effort, and which of them are simply masking vs compensating); (2) psychological studies to understand the personality, cognitive and contextual bases of camouflaging; and (3) clinical studies to assess the positive and negative consequences of camouflaging, as well as how camouflaging has an impact on the diagnosis of autism (e.g. whether higher levels of camouflaging result in delayed or missed diagnosis) and the identification of relevant clinical issues" (pp. 700).

Discussion

Surprisingly, there has been relatively little systematic scientific study of camouflaging despite it being commonly considered to be a key feature of females with ASD (e.g., European Union (EU)-funded Autism in Pink project, http://autisminpink.net/) (Lai et al., 2017). In the qualitative study carried out by Tierney and colleagues (2016) the participants reported examples where they engaged in sophisticated levels of peer imitation. One example given in the paper was times where the participant would pretend to be engaged in something such as reading a book when, what they were really doing, was watching peers so that they could learn to imitate their behaviours, mannerisms, etc. Females often engage in such behaviour to learn socially acceptable behaviours, for instance, in order to blend in and not be viewed as being different to others. These findings by Tierney and colleagues (2016) were consistent with the findings from the other qualitative studies identified in this review (Bargiela et al., 2016; Hull et al., 2017; Cook et al., 2018). Previous studies have suggested that girls and women with ASD may have more motivated to develop compensatory skills which enable them to present as "socially typical". Given this, it is possible that there is a differing developmental trajectory between males and females with ASD (Lai et al., 2011). The studies identified in this review highlight that social imitation or camouflaging enables some level of success and coping which results in some females never receiving a diagnosis of ASD (Hull et al., 2017). Further, they typically may not exhibit any observable functional impairments (e.g., Bargiela et al., 2016; Tierney et al., 2016; Hull et al., 2017). However, a number of the studies identified in this review highlighted some of the consequences of engaging in camouflaging strategies. For instance, under the surface of the camouflage, females may experience high levels of subjective stress, anxiety and exhaustion and a need to re-charge or recuperate by withdrawing from any social interaction (Bargiela et al., 2016; Tierney et al., 2016; Hull et al., 2017; Lai et al., 2017; Cook et al., 2018).

Is camouflaging equally common in males and females with ASD?

One of the key questions is whether the adoption of camouflaging strategies are more common in girls and women with ASD. Some studies identified in this review did indicate that camouflaging strategies are more common in females with ASD when compared to males with ASD (e.g., Dean et al., 2017; Lai et al., 2017) Parish-Morris et al., 2017; see also: Rynkiewicz et al., 2016). However, although not the focus of their study Hull and colleagues (2017) found relatively similar numbers of males and females, and all individuals of other genders, reported engaging in camouflaging strategies.

Furthermore, they did not identify the presence of any consistent patterns of differences in camouflaging strategies between males and females. Hull and colleague posit some potential reasons which might explain why they found relatively equal numbers of camouflaging practices in both males and females, for instance. For instance, the self-selecting nature of the sample who responded to a call for participants for 'a study looking at experiences of coping behaviours in social situations'. Prior experience of camouflaging, although not a requirement for participation in the study, may have been considered to be a requirement for people who saw this advert for the study. It is possible then that most of those who did not participate in the study, because they had never or only very occasionally engaged in camouflaging practices, may have been more likely to be male (Hull et al., 2017). Interestingly, Lehnhardt and colleagues (2016) hypothesised that, in males with ASD, verbal abilities may play a crucial role when it comes to engaging in camouflaging behaviour. Surprisingly, based on the data from a sample of 60 age- and IQ-matched men and women with ASD (with no comorbid intellectual disability) Lai and colleagues (2017) found, in both males and females with ASD, no evidence of a significant correlation between verbal ability and camouflaging (Lai et al., 2017).

There is an urgent need for further research investigating whether camouflaging strategies are more prevalent in females with ASD when compared to males with ASD. The relatively small number of studies to date investigating camouflaging have used female samples and not included a male group (Bargiela et al., 2016; Tierney et al., 2016; Cook et al., 2018).

Limitations

There are some potential limitations with the present systematic review. Primarily, there is the potential that relevant articles have not been identified in the search carried out on the databases. However, in order to reduce the risk of this the 'Googlescholar' search was carried out in addition to the database search. Also, all relevant papers were reviewed (including reference sections) for the purposes of identifying any potentially relevant articles which were not identified during the database searches.

Clinical Implications and Recommendations

Clinical considerations when using current ASD diagnostic and screening measures with females

Murray and colleagues (2017) examined whether there was any evidence of gender bias in one of the ASD screening tools, the (AQ-10, Allison, Auyeung, & Baron-Cohen, 2012), specifically whether it

under-identifies females with the disorder. The AQ-10 has been found to be a reliable and valid measures (e.g., Booth, Murray, McKenzie, Kuenssberg, O'Donnell, & Burnett, 2014). The sample in their study comprised of 557 females and 680 males who reported a diagnosis of ASD. Findings revealed that there were item level sex biases. Importantly, sometimes these item level sex bias would favour males and sometimes females. For instance, for AQ28 ("I usually concentrate more on the whole picture, rather than the small details.") the bias favoured females (for the same latent trait level, compared to males, females were more likely to endorse the item). The bias was in the opposite direction for AQ32 ("I find it easy to do more than one thing at once."), favouring males. Given this finding, Murray and colleagues (2017) suggest that, overall, there is an unbiased score and therefore it is still a clinically useful tool. It does, nevertheless, highlight the caution that needs to be exerted when trying to form any interpretation based on the individual's responses to single items (Murray, Allison, Smith, Baron-Cohen, Booth, & Auyeung, 2017).

Sensory symptoms is also another area worthy of exploration in both males and females with ASD (see Crane, Goddard, & Pring, 2009), particularly for females (Gould, 2017). There has been relatively little study investigating any sensory differences between males and females (Lai et al., 2011). Lai and colleagues (2011) found that adult females with ASD experienced more lifetime sensory symptom. The Diagnostic Interview for Social and Communication Disorders (DISCO) (Wing et al., 2002) enables a clinician to also develop a detailed profile of the individual which can be more useful in identifying the needs of the individuals than a diagnostic label (Gould, 2017).

The need for support in individuals with ASD who successfully engage in camouflaging behaviours

It could be argued that if some individuals are engaging in camouflaging behaviours so successfully that they are not identified and diagnosed, then do they really need a diagnosis and support? As argued by Hull and colleagues (2017) although it would seem reasonable to consider camouflaging as a useful and a strategy which is relatively low-impact, the significant difficulties (e.g., exhaustion) described by the respondents in the study carried out by Hull and colleagues (2017) strongly advocates that individuals who engage in successful camouflaging strategies still require access to appropriate support (Hull et al., 2017).

The Camouflaging Autistic Traits Questionnaire (CAT-Q)

Hull and colleagues (2018) recently developed The Camouflaging Autistic Traits Questionnaire (CAT-Q). A real strength of this questionnaire is that it was developed based on autistic adults' experiences

of camouflaging. Therefore helping to ensure that behaviours, which non-autistic clinicians and researchers may not have considered to be features of camouflaging, can be assessed. The CAT-Q was administered online to 354 autistic and 478 non-autistic adults. Based on the autistic adults' experiences of camouflaging 48 items were included in the study. When completing the CAT-Q, participants were asked to respond to each of the 45 statements using a seven-point Likert scale, from 'Strongly Disagree' to 'Strongly Agree'. Exploratory factor analysis identified three factors, 25 items in total. The three-factor structure consisted of Compensation (strategies which are employed to compensate for impairments in the social and communication domain), Masking (strategies which are employed in order to present a non-autistic or less autistic persona to other people) and Assimilation (strategies which are used to fit in to social situations which are uncomfortable). Hull and colleagues (2018) showed that the CAT-Q had robust psychometric support and is appropriate for use (no need to vary the use) in clinical and non-clinical populations (even if ASD diagnostic criteria changes in the future). Therefore, the CAT-Q does not need a formal diagnosis of an ASD for camouflaging behaviours to be assessed. Also, the scores on the CAT-Q can be compared between males and females.

In this study, the CAT-Q was found to have acceptable to good internal consistency and reliability over a three month duration (Hull, Mandy, Lai, Baron-Cohen, Allison, Smith, & Petrides, 2018). Some of the questions in the CAT-Q include: 'I learn how people use their bodies and faces to interact by watching television or films, or by reading fiction'; 'In my own social interactions, I use behaviours that I have learned from watching other people interacting'; 'I have researched the rules of social interactions (for example, by studying psychology or reading books on human behaviour) to improve my own social skills'; 'I monitor my body language or facial expressions so that I appear interested by the person I am interacting with'; 'I am always aware of the impression I make on other people' and 'In social situations, I feel like I'm "performing" rather than being myself' (Hull et al., 2018).

However, Hull and colleague point out that the test–retest reliability analyses were carried out only in the older autistic sample, and recommend that further research is needed to replicate these analyses using samples of autistic and non-autistic individuals which are more diverse. Hull and colleagues also recommend that the CAT-Q "can be used in combination with observed behavioural and cognitive measures of camouflaging to assess all aspects of this complex phenomenon" (Hull et al., 2018). They also state that the CAT-Q may have "clinical implications to identify levels of camouflaging along with other clinical information, including those derived from current autism diagnostic measures, to enhance the sensitivity and specificity of clinical diagnosis, formulation, and support planning" (Hull et al., 2018). However, Hull and colleagues argue that the clinical utility of this new questionnaires needs further clinical research.

Future Research Directions

Firstly, future research needs to include females with a range of 'severity' levels of ASD symptomology (Bargiela et al., 2016). Also, Bargiela and colleagues (2016) emphasis that another area that is worthy of further exploration is the impact of the female phenotype on risk of being unidentified in other countries which have different healthcare systems (Bargiela et al., 2016). A number of other future research directions are reviewed below.

The need for further research exploring the positive and negative impact of 'camouflaging'

The capacity to 'camouflage' social difficulties in social situations is considered to be one of the main features of the female phenotype of ASD (e.g., Kenyon 2014). Social imitation or camouflaging enables some level of success and coping which results in some females never receiving a diagnosis of ASD. They typically may not exhibit any observable functional impairments**.** However, under the surface of the camouflage, females may experience high levels of subjective stress, anxiety and exhaustion and a need to re-charge or recuperate by withdrawing from any social interaction. For instance, take the example of a female with ASD who is a highly successful teacher and her colleagues would never suspect she had ASD. However, after a day at work she needs to lie down in a dark room to recuperate from the day at work and camouflaging. In some woman an hour or less is needed but some need many more hours to recuperate. Surprising, this particular theory of the female phenotype remains are area which has received no empirical or systematic study (Gould & Ashton-Smith, 2011; Kopp & Gillberg, 1992; Lai, Lombardo, Auyeung, Chakrabarti, & Baron-Cohen, 2015; Robinson et al., 2013; Hull et al., 2017).

In individuals with ASD, it is important to highlight that camouflaging is not a behaviour that should be always expected or encouraged. It has been posited that camouflaging can have a negative effect on the individual's mental health (Holliday-Willey 2015). Currently there is relatively little knowledge about the types of cognitive strategies which enable individuals with ASD to adopt camouflaging behaviours (Lehnhardt et al., 2016). Research is needed to further our knowledge and understanding of the individual differences associated with a variety of long-term outcomes (such as wellbeing) in both males and females with ASD who engage in camouflaging or masking behaviours (Hull et al., 2017). There is a need for clinical studies in order to investigate what the positive and negative consequences of camouflaging with this population may actually be (Lai et al., 2017). Further

clinical studies are also urgently needed to investigate whether camouflaging is associated with the age of diagnosis. For instance, exploring if there is a delay in time of diagnosis or missed diagnosis in individuals who exhibit much greater levels of camouflaging (Lai et al., 2017).

Some of the specific research questions surrounding camouflaging in ASD include: 'What is the prevalence of camouflaging in individuals with ASD?'; 'Does the phenomenon of camouflaging vary across the lifespan of the individuals – are there any age differences?'; 'Are there any gender differences in camouflaging?'; 'what are the positive and negative effects of engaging regularly in camouflaging?'; 'Is there anything that educational institutions and workplaces could do in order to reduce the level of camouflaging that individuals with ASD have to adopt?'. Lastly, research is also required to investigate whether any individual differences in camouflaging are associated with long-term outcomes in functioning (social, mental health, etc), achievement and quality of life (see Bargiela et al., 2016; Hull, Petrides, Allison, Smith, Baron-Cohen, Lai, & Mandy, 2017).

The need for the development of a camouflaging measure

Although there has been some interesting study in this area (e.g., Baldwin & Costley, 2015; Cridland et al., 2014; Mandy & Tchanturia, 2015; Rynkiewicz et al., 2016: see also Hull et al., 2018), there is still the urgent need for further research in order to 'operationalize the construct of camouflaging'. Self-report should be used in the first instance when developing this measure of camouflaging measure, due to the covert nature of this behaviour (Bargiela et al., 2016). This research would help inform the development of measures of camouflaging behaviours. Such measures would enable the standardisation and also the comparison of experiences of camouflaging between individuals with and without a diagnosis of ASD. Follow-up quantitative research could then be carried out (Hull et al., 2017). Lastly, the 'nature of the item level sex biases' in screening and diagnostic assessments for ASD could help inform the direction of future research into the way in which ASD (and camouflaging) is exhibited in males and females (Murray et al., 2017).

Investigating gender and sex differences in camouflaging behaviours

A number of studies have suggested that engaging in camouflaging strategies which are successful may result in the individual receiving a late diagnosis, if at all (e.g., Hull et al., 2017). Given this, there may be a significant number of both males and females with ASD who are not receiving the appropriate support. Research could investigate this further by comparing levels of camouflaging behaviour in both males and females who have high traits of ASD but who have no diagnosis of ASD.

This may reveal more about how camouflaging differs between those who do receive an ASD diagnosis compared to those who do not (Hull et al., 2017). Research investigating the consequences of camouflaging (both positive and negative) in all genders is urgently needed in order to attempt to elucidate the challenges and barriers experienced in accessing support by individuals who do not exhibit what would be considered to be a 'typical' presentation of ASD (Hull et al., 2017).

Need for future studies to include larger and more varied sample of individuals across the autism spectrum

Another recommendation for future research is to include larger and more varied samples of individuals from across the autism spectrum in order to enhance our understanding of camouflaging behaviour (e.g., Hull et al., 2017). For instance, to further refine our understanding of how camouflaging both develops and changes across the lifespan, there is a need for additional research using both a qualitative and quantitative approach to compare the camouflaging experiences of individuals from a variety of age groups (Hull et al., 2017). Some of the studies identified in the present review just focused on a certain age group. For instance, Tierney and colleagues (2016) sample comprised of 10 adolescent females with a diagnosis of ASD.

Conclusions

There is a real need for further research to investigate the female phenotype of ASD in order to increase our understanding and knowledge. This lack of understanding and knowledge impacts significantly on the ability to identify females with ASD (Lai et al., 2015; Bargiela et al., 2016) which can have a number of negative consequence (Adamou et al., 2018; NICE, 2012). As highlighted earlier, the capacity to 'camouflage' social difficulties in social situations is considered to be one of the main features of the female phenotype of ASD (e.g., Kenyon 2014). However, despite this, there is relatively little empirical research investigating this phenomenon. The studies identified in this review highlight that social imitation or camouflaging enables some level of success and coping which results in some females never receiving a diagnosis of ASD. Further, they typically may not exhibit any observable functional impairments. However, under the surface of the camouflage, females may experience high levels of subjective stress, anxiety and exhaustion and a need to re-charge or recuperate by withdrawing from any social interaction.

Conflicts of Interest

The author(s) have no conflicts of interest to declare.

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Table 1. Studies identified in the review: Characteristics and main findings.

Authors	Sample	Methodology	Primary Outcome Variables	Main Findings
Bargiela, Steward, & Mandy (2016)	14 women with ASC (aged 22–30 years) diagnosed in late adolescence or adulthood.	Qualitative study - Framework Analysis.	Semi-structured interview - in-depth accounts of: 'pretending to be normal'.	Participants provided in-depth accounts of: 'pretending to be normal'; of how their gender led numerous professionals to miss their ASD and of the conflicts they experienced between ASD and the traditional feminine identity. This table will focus on reporting some of the key findings in relation to the accounts of 'pretending to be normal'. The majority of the participants reported that in childhood their teachers did not identify their difficulties. However, the other children were very sensitive to their differences. All the women in the sample reported that socialising as part of large groups was challenging. In order to cope with this, many of the women in the sample reported that in certain social situations they would engage in behaviours such as 'wearing a mask' or adopting a certain 'persona'. The study also highlighted that masking was another study use by many of the women in order hide autistic traits so that they would appear 'normal' to others. For instance, one woman reported that she used her 'mask' as a 'double-bluff' technique to openly joke about an element/feature of her behaviour that her peers may have considered to be an autistic feature. In another example provided by the authors, they describe a woman in their sample who reported learning phrases and facial expressions from fictional literature to help her manage situations which were particularly unpleasant (e.g., bullying).

				Another important finding from the present study was negative consequences as a result of employing the masking/camouflaging/mimicking behaviours for coping in social situations. For instance, many young women had found that the effort that was needed to process consciously people's behaviours and act them out later, was exhausting.
				Some other participants in the study reported that pretending to be someone else had resulted in them experiencing feelings of confusion surrounding their identity. Interesting, some of the participants in the study had "acted neurotypical" (P07) in such a convincing way that there were occasions where they had questioned their ASD diagnosis.
Cook, Ogden, & Winstone (2018)	11 girls with ASD (aged between 11–17 years) and one parent of each girl.	Qualitative study - Thematic analysis	Semi-structured interviews.	The study highlighted that some of the parents observed that their daughters could effectively hide the characteristics of their ASD. Many of the parents reported how well their daughters were able to cope or how they were able to make adjustments to their behaviour in order to fit in. Therefore, the 'masking' behaviour provided the girls with a solution to some of the social difficulties they were experiencing. However, the parents also reported that the 'masking' behaviour could have negative consequences such as resulting in a late diagnosis or misdiagnosis.
				They found that many of the girls were highly articulate and there were some cases where the parents described their child adopting the tone and mannerisms of other girls they had observed as being socially skilled. For instance, one of the participants described that she would imitate the voice of a YouTube star when she talked to her mother about what she had done that day. Cook and colleagues also describe the case of Leah who made a conscious attempt to change her personality in order to try and fit in. There was also a reluctance to be given a label in some of the girls and also a

				preference to hide their differences. In some cases, this would have a beneficial impact in terms of friendship groups and how included in these groups they felt.
				The study also found that there were a number of negative consequences as a result of engaging in the 'masking' behaviours. It would reported that it led to symptoms of ASD going unidentified; the development of more significant (e.g., falling behind at school and social difficulties).
Dean, Harwood, & Kasari (2017)	96 elementary school children (ASD = 24 girls and 24 boys, typically developing = 24 girls and 24 boys).	Concurrent mixed methods (quantitative and qualitative simultaneously)	The Playground Observation of Peer Engagement (POPE)	Findings were consistent with the camouflage hypothesis. Specifically, girls with ASD were found to adopt compensatory behaviours (including remaining close in proximity to peers) which masked their social difficulties. Such compensatory behaviours may be one of the reasons why ASD is less easy to detect in females with ASD compared to males. The girls with ASD appeared to use compensatory behaviours in order to gain access into peer groups that may mask their social challenges when compared to the typically developing (TD) girls, who are readily accepted into activities with peers. The authors give some examples. For instance, one of the girls with ASD was observed to flit between Joint Engage and Solitary which indicated her difficulties in maintaining mutual involvement in social groups. In another example, one girl with ASD maintains Game by swinging a jump rope throughout the observation session. However, she is never given a turn to jump which highlights the social challenges.
Hull, Petrides, Allison, Smith, Baron-Cohen,	92 adults with ASD (Female = 55, Male = 30, Other Gender = 7).	Qualitative study - Thematic analysis was used to identify key	Semi-structured interviews.	Findings showed that the motivations for engaging in camouflaging behaviour included fitting in and increasing connections with others.

Lai, & Mandy (2017)	3 male participants reported their natal sex as female. All participants who identified their gender as 'Other' reported their natal sex as female.	features of camouflaging in order to inform the development of a three-stage model of the camouflaging process.		Moreover, camouflaging itself was reported to consist of a combination of both masking and compensation strategies. Lastly, a number of short- and long-term consequences of engaging in camouflaging behaviour were reported such as exhaustion, challenging stereotypes and threats to self-perception. They found that the respondents felt (either from themselves or others) significant pressure to be effective at camouflaging. However, many of the respondents were unsure just how effective their camouflaging strategies actually were. Interestingly, 21 respondents (10 male and 11 female) reported not being successful in their attempts at camouflaging or reported not achieving the intended outcomes. A minority of respondents described feeling satisfied and relieved following a camouflaging session. Camouflaging was rewarding for these individuals because it enabled them to achieve what they wanted (e.g., getting through a necessary social situation or connecting with others socially). 60% of the individuals who reported feeling positive or relieved after camouflaging were male (n = 9, compared to six females), in contrast to most of the female total sample.
Lai, Lombardo, Ruigrok, Chakrabarti, Auyeung, Szatmari, ... & MRC AIMS	30 adult females and 30 adult males with autism (none with intellectual disability) matched for	Behavioural and cognitive measures Neuroimaging	**Behavioural and Cognitive Measures** Camouflaging was operationalised using standardised measures.	**Findings from the behavioural and cognitive measures** The operationalised camouflaging measure was not found to be significantly correlated with either age, VIQ, PIQ or FIQ.

Consortium. (2017)	age (18–49 years), verbal IQ (VIQ), performance IQ (PIQ) and full-scale IQ (FIQ).		Participants were assessed using the Wechsler Abbreviated Scale of Intelligence for the estimation of verbal IQ (VIQ), performance IQ (PIQ) and full-scale IQ (FIQ). The Autism Diagnostic Interview–Revised (ADI-R) was used to assess childhood ASD characteristics. Module 4 of the ADOS (Lord et al., 2000) was used to quantify current, adult ('external') behavioural characteristics related to ASD. The Autism Spectrum Quotient (AQ) was used to measure participants' self-reflection ('internal' perception) of their personal characteristics associated with ASD. The 'Reading the Mind in the Eyes' Test (RMET)	Females with ASD were found to have higher camouflaging scores compared to the males with ASD, on average. There was substantial variability found in both groups. Findings also revealed that there was an association between greater camouflaging and more depressive symptoms in men and improved signal-detection sensitivity in women with ASD. There was no significant relationship between camouflaging and anxiety symptoms in either sex or gender. **Findings from the neuroimaging strand of the study: Testing for association between regional grey matter (GM) volume and camouflaging** The brain volumetric associations with camouflaging were largely sex/gender-dependent. When investigating the association between GM volume and camouflaging, the present study found statistically significant sex/gender-dependent association patterns. However, no region was found that showed a significant overall correlation with camouflaging across sex/gender at the same statistical threshold. When dissecting the sex/gender differential pattern, findings revealed no association in males but there was evidence of a significant negative correlation in females (i.e. the higher camouflaging, the smaller regional volume). In sum, this study found that the neuroanatomical association with camouflaging score was largely sex/gender-dependent (particularly around the medial temporal and cerebellar structures) and was only significant in women.

			was used to measure participants' actual ('internal') capability in advanced mentalising and complex emotion recognition. The 21-item Beck Anxiety Inventory (BAI) and the 21-item Beck Depression Inventory (BDI). An online version of the Go/No-Go task and derived performance measures using the signal detection theory (SDT) framework. **Neuroimaging Measure** Participants were scanned using a contemporary 3 T MRI scanner (GE Medical Systems HDx) fitted with an 8-channel receive-only RT head-coil using Driven Equilibrium Single Pulse Observation of T1 (DESPOT1).	

Parish-Morris, Liberman, Cieri, Herrington, Yerys, Bateman, ... & Schultz (2017)	65 verbal school-aged participants with ASD (49 boys and 16 girls, IQ estimates in the average range). Comparison group consisted of typically developing (TD) children (8 boys and 9 girls).	Quantitative	Speech samples from the Autism Diagnostic Observation Schedule (ADOS) were orthographically transcribed and time-aligned - filled pauses were marked. Parents were asked to complete two measures: the Social Communication Questionnaire and the Vineland Adaptive Behavior Scales.	Note: Pauses during conversation can be filled with words like UM or UH. Research has suggested that these two words are pragmatically distinct (e.g., UM is used to signal longer pauses, and may correlate with greater social communicative sophistication compared with UH). Findings revealed that girls with ASD and typical girls/boys displayed higher UM ratios compared to the boys with ASD. However, the girls in both diagnostic groups were found to suppress UH when compared to their male counterparts. The authors highlight that the filled pause differences in boys and girls with ASD were not attributable to increased social pragmatic ability in girls. This is because the girls and boys included in the study had equivalent social communication skills and similar levels of severity of ASD symptomology. The findings indicate that UH suppression and higher UM ratios may potentially be used as "linguistic camouflage" in order to normalise the way a girl with ASD sounds when compared to same-aged typical peers, while higher rates of UH (relative to UM) may result in boys with ASD sounding particularly atypical. Whether an intentional strategy or not, overtly typical-sounding speech in girls could have some positive impacts such allowing a child to "blend in" more easily with their peers. This may also have an impact on the identification of ASD resulting in missed or late diagnosis (as well as misdiagnoses which have been found to more frequent in girls).
Rynkiewicz, Schuller, Marchi, Piana, Camurri,	33 high-functioning Polish girls and boys with	Quantitative	Participants were examined during two demonstration activities	During the two demonstration activities of the ADOS-2, the findings revealed that girls with ASD exhibited a tendency to utilise gestures in a more vivid way when compared to the boys with ASD. High-

Lassalle, & Baron-Cohen (2016)	formal diagnosis of autism or Asperger syndrome aged 5-10, with fluent speech, IQ average and above and their parents (girls with autism, n = 16; boys with autism, n = 17).		of Module 3 of ADOS-2 which was administered in Polish and coded using Polish codes. Children were also examined using Polish versions of the Eyes and Faces Tests. Parents gave information for the author-reviewed Polish research translation of SCQ (Social Communication Questionnaire, Current and Lifetime) and the Polish version of the AQ Child (Autism Spectrum Quotient, Child).	functioning females with ASD may present better on non-verbal (gestures) mode of communication when compared to the boys with ASD. Specifically, the girls with ASD exhibited the higher Gesture Index which is interpreted as gestures which have an increased energy, are more "vivid" and as a result, may be more easily identifiable by a human examiner/observer. This may camouflage other diagnostic features of ASD in the females with ASD. The girls with ASD exhibited impairment on the Faces Test. On the parent-report screening tests, there is either the absence of difference (AQ) or parents rate the boys with ASD as presenting with less affected communication (SCQ).
Tierney, Burns, & Kilbey (2016)	10 adolescent females with a diagnosis of ASD	Qualitative analysis - Interpretative Phenomenological Analysis	A semi-structured interview schedule was developed based on the questions originating from the existing literature. The newly developed semi structured interview was piloted with two adolescents with ASD.	Findings showed that the majority of females in the sample had developed sophisticated strategies which employed innate strengths. These sophisticated strategies enabled them to appear competent socially to others. Masquerading strategies were frequently used by the adolescent females in the sample in the present study in order to hide/overcome obstacles to developing and maintaining friendships and also helped them to manage their socio-communication impairments. The employment of these masquerading strategies, for most of the participants, resulted in a number of negative consequences including a negative impact on their psychological wellbeing and

| | | | | potentially hindered their access to appropriate and timely support given that they were masking or hiding their impairments.

The authors also highlight that none of the strategies (such as masking or imitation) or characteristics (such as the motivation to have friends) which were reported by the females with ASD are assessed for in diagnostic assessment for ASD. |
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