RESEARCH ARTICLE

Recognition of Girls on the Autism Spectrum by Primary School Educators: An Experimental Study

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Autism has long been considered a predominantly male condition. It is increasingly understood, however, that autistic females are under-recognized. This may reflect gender stereotyping, whereby symptoms are missed in females, because it is assumed that autism is mainly a male condition. Also, some autistic girls and women may go unrecognized because there is a "female autism phenotype" (i.e., a female-typical autism presentation), which does not fit current, male-centric views of autism. Potential biases shown by educators, in their role as gatekeepers for an autism assessment, may represent a barrier to the recognition of autism in females. We used vignettes describing autistic children to test: (a) whether gender stereotyping occurs, whereby educators rate males as more likely to be autistic, compared to females with identical symptoms; (b) whether recognition is affected by sex/gender influences on autistic presentation, whereby children showing the male autism phenotype are rated as more likely to be autistic than those with the female phenotype. Ratings by primary school educators showed a significant main effect of both gender and presentation (male phenotype vs. female phenotype) on estimations of the child in the vignette being autistic: respondents showed a bias against girls and the female autism phenotype. There was also an interaction: female gender had an effect on ratings of the female phenotype, but not on the male phenotype vignette. These findings suggest that primary school educators are less sensitive to autism in girls, through under-recognition of the female autism phenotype and a higher sensitivity to autism in males. ***Autism Res*** *2020, 00: 1–15.* © 2020 The Authors. *Autism Research published by International Society for Autism Research* published by Wiley Periodicals, Inc.

Lay Summary: Educators have an important role in identifying children who need an autism assessment, so gaps in their knowledge about how autism presents in girls could contribute to the under-diagnosis of autistic girls. By asking educators to identify autism when presented with fictional descriptions of children, this study found that educators were less able to recognize what autism "looks like" in girls. Also, when given identical descriptions of autistic boys and girls, educators were more likely to identify autism in boys. These results suggest that primary school educators might need extra help to improve the recognition of girls on the autism spectrum.

Keywords: autism; sex; gender; female; stereotype; recognition; teacher; educator

Introduction

Autism is a neurodevelopmental condition defined by early-emerging difficulties in social-communication, social reciprocity, sensory processing, and flexibility [American Psychiatric Association, 2013]. Since its first description, the number of males with a diagnosis of autism has been significantly higher than the number of females [Asperger, 1944; Kanner, 1943]. Although prevalence studies show that the male-to-female ratio of autism diagnosis varies between studies, ranging from 3:1 to 7:1, the rates of diagnoses among males always exceed those of females [Halladay et al., 2015].

This high male-to-female ratio of diagnosed autism is, in part, due to an under-recognition of females with the condition. A recent meta-analysis of prevalence research found that in studies that reported on samples of individuals with a preexisting clinical diagnosis, the male-to-female ratio was 4.6 to 1 [Loomes, Hull, & Mandy, 2017]. By contrast, in those studies that used an active case ascertainment strategy, seeking to identify autistic[1]

[1]We use "identify-first" language ("autistic person") rather than person-first language ("person with autism"), because it is the preferred term of autistic activists [e.g., Sinclair, 1999] and many autistic people and their families [Kenny et al., 2016] and is less associated with stigma [Gernsbacher, 2017].

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Received October 22, 2019; accepted for publication April 14, 2020

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Published online 00 Month 2020 in Wiley Online Library (wileyonlinelibrary.com)
DOI: 10.1002/aur.2316

people within a given population regardless of any prior assessment or concerns, the male-to-female ratio was significantly lower, at 3.3 to 1 [Loomes et al., 2017]. This disparity suggests that a substantial proportion of females who meet the criteria for autism do not receive an assessment and subsequent diagnosis.

The bias against autistic girls and women is further demonstrated by evidence that females tend to receive their diagnosis later than boys, despite similar ages of first concern [Begeer et al., 2013; Rutherford et al., 2016]. Furthermore, among girls and boys with similarly high levels of autistic traits, girls are less likely to receive an autism diagnosis [Russell, Steer, & Golding, 2011]. Several studies have also shown that girls diagnosed with autism tend to have more autistic traits than autistic boys, as well as additional behavioral difficulties, suggesting that, in order to get a diagnosis, girls may require more severe autistic difficulties, and higher levels of co-occurring difficulties [Duvekot et al., 2017; Dworzynski, Ronald, Bolton, & Happé, 2012; Lundström et al., 2019].

For those girls and women whose autism goes undetected, the negative consequences can be far-reaching. Autistic people who have lived without a diagnosis report that this results in greater social isolation and bullying, as well as feelings of being misunderstood or "not fitting in" [Bargiela, Steward, & Mandy, 2016; Portway & Johnson, 2003, 2005; Punshon, Skirrow, & Murphy, 2009]. Furthermore, an autism diagnosis can bring access to services, lead to the identification of individual needs and interventions, and result in the provision of support to family members [Bryson, Rogers, & Fombonne, 2003]. Similarly, it can help individuals develop a positive autistic identity and a sense of belonging in the autistic community [Giles, 2014; Parsloe, 2015]. As such, females who do not receive a diagnosis, or who are delayed in receiving this diagnosis, are placed at risk of missing out on appropriate support.

Although the literature shows there is a diagnostic bias against autistic females, the underlying mechanisms are unclear. As a step toward filling this gap in knowledge, Bargiela et al. [2016] conducted a qualitative study with 14 late-diagnosed women to generate hypotheses about why autistic girls and women are at higher risk of their condition going unrecognized. All participants reported that, during their childhood, professionals had been aware that they experienced difficulties but had failed to associate these with being autistic. Missing out on an autism diagnosis was attributed to two key factors. First, participants suggested that family doctors (in the UK "General Practitioners" [GPs]) and educators (i.e., qualified teachers, trainee teachers, and teaching assistants) often missed the signs of autism in females because they held a mistaken belief that autism is a male condition, and therefore unlikely to occur in females. Participants felt that these *gender stereotypes* reduced GPs' and educators' sensitivity to autism symptomatology in females.

A recent experimental study offers some support for the idea that gender stereotypes might influence the perception of autistic characteristics [Geelhand, Bernard, Klein, Van Tiel, & Kissine, 2019]. Members of the general public read written descriptions of autistic-like behaviors in fictional 5-year-old children, and rated how "worrying" they considered these behaviors to be, and how indicative they were of future atypicality in adolescence. Crucially, the gender of the child in the written descriptions was manipulated, to examine whether gender influenced participants' ratings. While gender did not affect how "worrying" the described autistic symptoms were judged to be, it did influence perceptions of future atypicalities. Autistic characteristics presented in girls were considered less indicative of future, adolescent problems compared to identical characteristics presented in boys. It was as if participants assumed that the girls were more likely to grow out of their difficulties.

A second idea generated by Bargiela et al.'s [2016] analysis to explain why autistic girls fly under the diagnostic radar concerned a lack of understanding among professionals about how autism presents in females—that is, of the *female autism phenotype*. The female autism phenotype refers to the idea that sex and gender partly influence how autism presents, with females tending to show a sex- or gender-specific behavioral manifestation of autism [Lai, Lombardo, Auyeung, Chakrabarti, & Baron-Cohen, 2015]. The male and female (and other sex- and gender-related) autism phenotypes share many commonalities, but the current literature suggests four key features that are especially characteristic of autism as it presents in girls and women [Hull, Petrides, & Mandy, 2020]. First, on average, autistic females show higher social motivation in comparison to autistic males, demonstrating more interest in friendships and other relationships [Hiller, Young, & Weber, 2014; Sedgewick, Hill, & Pellicano, 2019; Sedgewick, Hill, Yates, Pickering, & Pellicano, 2016]. Second, many autistic people seek to "camouflage" their autism and this appears to be more common in females [Hull et al., 2019]. Camouflaging involves trying to mask or compensate for autistic characteristics, and can include such strategies as practicing gestures and facial expressions, and forcing oneself to make eye contact [Bargiela et al., 2016; Hull et al., 2017, 2019]. Third, autistic people often experience co-occurring emotional and behavioral difficulties, and there is emerging evidence that these may be partially influenced by gender. Males show more externalizing difficulties, while females are more likely to develop internalizing difficulties like anxiety or eating disorders [Mandy et al., 2012; Westwood et al., 2016]. Fourth, restrictive and repetitive behaviors/interests can be influenced by sex and gender

[Hiller et al., 2014]. The intense interests seen in autistic boys are often focused on mechanics and mathematics, while autistic females are more likely to have socially focused (e.g., other girls, novels) and/or more normative interests (e.g., animals, pop stars) [Bargiela et al., 2016; Hiller, Young, & Weber, 2016]. As suggested by the women interviewed in Bargiela et al. [2016], it is plausible that this female autism phenotype might contribute to the observed diagnostic bias. This would be due to professionals holding an understanding of autism that reflects a more male-typical presentation, while having insufficient awareness of how it can manifest differently in some girls and women.

Bargiela et al.'s [2016] findings highlight the key role that educators play in identifying difficulties in children and helping direct them toward an autism assessment. Educators are often gatekeepers to assessment for autism and diagnosis—yet their knowledge of autism can be limited and they may have particular difficulty recognizing autism in girls [Hiller et al., 2014; Posserud, Lundervold, & Gillberg, 2006]. Although educators cannot all be expected to be specialists in autism, primary school educators can play an especially important role, as they can facilitate the recognition of autistic features in a timely fashion given they have access to the richest social-communication encounters of the children (i.e., in the school setting), before they transition to secondary education and enter adolescence. Educators can support children in whom they recognize autistic characteristics via diverse channels. These include (a) seeking help within the school (e.g., from colleagues with knowledge of supporting special needs), (b) consulting within the wider educational system (e.g., with educational psychologists), and (c) recommending input from a medical or mental health professional [Farmer, Burns, Phillips, Angold, & Costello, 2003].

The current study sought to test one putative factor that could underlie the diagnostic bias against autistic females, namely insufficient understanding among primary school educators about autism in girls. We addressed this aim by presenting primary school educators with written vignettes, describing children with various clinical characteristics, and asking them to rate (a) the likelihood of the described child being autistic; and (b) the likelihood of them seeking help for the described child. Specifically, we sought to investigate two hypotheses.

Hypothesis 1: Gender stereotypes will influence educators' decision-making.

Educators who are presented with a vignette describing a male autistic child ("Jack"), compared to educators presented with a vignette that is identical, except that it describes a female child ("Chloe"), will: (a) judge the male child as more likely to be autistic; and (b) be more likely to seek help for that child.

Hypothesis 2: The female phenotype will influence educators' decision-making.

Regardless of the gender of the child described, when educators are presented with a vignette describing the "male autism phenotype," compared to when they are presented with a vignette describing the "female autism phenotype," they will: (a) judge the male phenotype child as more likely to be autistic; and (b) be more likely to seek help for that child.

In addition to testing these a priori hypotheses, we explored whether some educator characteristics are associated with greater or lesser sensitivity to the male and female autism phenotype, as presented in the vignettes. We reasoned that such analyses could provide initial insights into how to support educators in becoming more effective at identifying pupils with undiagnosed autism. Past research shows that professionals' personal contact with autistic people is associated with better knowledge of autism [Dillenburger et al., 2013; Unigwe et al., 2017]. On this basis, we investigated whether teachers with more direct personal and professional experience of autistic people would be more sensitive to the autism vignettes. Also, we explored whether those educators who reported having had autism-specific training were better at recognizing the autistic children in the vignettes.

Method

Participants

This study used convenience sampling through social media adverts to recruit 289 primary school educators. Specifically, to be included in this study, participants were required to (a) complete all items in the survey, and (b) have current or previous experience of working in an educational capacity within a UK primary school or have received (or are currently receiving) training to teach in a primary school. This criterion led to the inclusion of qualified teachers, trainee teachers, and teaching assistants. Any individuals who worked in a school but not in a directly educational capacity (e.g., data manager, administrator) were excluded, along with those who did not complete the entire survey.

Design

Participation involved reading a series of four vignettes and answering questions based on their content. The four vignettes depicted fictional children with: (a) the male autism phenotype, (b) the female autism phenotype, (c) separation anxiety, and (d) attention-deficit/hyperactivity disorder (ADHD), respectively. The two latter vignettes were used as distractors to avoid biases that would arise if participants realized that the study was focused on the identification of autism. The choice

of these conditions (ADHD and separation anxiety) for the distractor vignettes was based on consultation with teachers and clinicians, which showed that these are two of the most common conditions that present in the primary school context. The sequence in which the four vignettes were presented was randomized for each participant.

After each vignette, respondents were asked a series of seven questions (see Supplementary Materials for full details). The first four questions asked the respondents to rate the likelihood of the child depicted in that vignette having: (a) "an autism spectrum disorder," (b) "an anxiety disorder," (c) "attention-deficit/hyperactivity disorder," and (d) "a disruptive behavioral disorder, such as, conduct disorder or oppositional defiant disorder." The next three questions concerned how likely they would be to seek additional support for the child depicted in the vignette. These questions asked about three different sources of support: (a) within the school (e.g., the school special educational needs coordinator [SENCO]), (b), an educational psychologist, and (c) a medical (e.g., GP) or mental health professional. We decided to ask about these three different support sources based upon our discussions with teachers and clinicians. This told us that there are different sources of support that teachers can draw upon, and suggested that educator decision-making might vary according to the source of support. We, therefore, designed the study to be sensitive to such potential variations in decision-making. For each of the seven questions that followed each vignette, participants gave their responses on a scale ranging from 0 ("Extremely Unlikely") to 100 ("Extremely Likely").

There were two independent variables in the experiment: (a) gender of the child (*Hypothesis 1*: "Jack" vs. "Chloe") and (b) type of autism presentation (*Hypothesis 2*: male autism phenotype vs. female autism phenotype). Type of autism presentation was a within-participant variable, such that every respondent received both the female autism phenotype and the male autism phenotype vignettes, along with the two distractor vignettes on ADHD and separation anxiety. Gender was a between-participant variable; for each vignette—including the distractor vignettes—the gender was randomized, with approximately half of the respondents reading the vignette presented as a girl ("Chloe"), and the other half reading the vignette presented as a boy ("Jack"). Critically, for this between-participant manipulation, the only difference in vignette content was the protagonist name and gender-specific pronouns. This is a "Balaam's design," in which each respondent was randomly assigned to one of four possible combinations of vignette and autism presentation (see Table S1).

Vignette Development

Vignettes were developed via an iterative process of consulting experts, including an autistic adult, as well as clinicians, researchers, and educators. Extensive efforts were made during the development of the four vignettes to ensure that they were carefully matched in terms of the target child (a 7-year-old pupil), the number of condition-specific pieces of information (five for each vignette), and vignette length (180–200 words). The condition-specific information reflected central features for each condition and, in the case of the "female autism phenotype" vignette, the relevant literature as described in the Introduction. To make the focus of the study less obvious, and thereby avoid expectancy effects and other biases, we also structured each vignette to include information on one co-occurring mental health condition and one physical health concern. Furthermore, we ensured that the information included in each vignette was as gender-neutral as possible. For example, for the "male autism phenotype," we referred to an intense interest in Harry Potter in the vignette, which is known to be enjoyed by both boys and girls alike, rather than interests more commonly associated with males, such as trains or cars. This aspect of the design enabled us to change only the name and gender pronouns for each condition-specific vignette, while keeping the remainder of the vignette unchanged. The vignettes' structure and key content are in Table 1. Also, we present the text of the male and female autism phenotype vignettes in the Supplementary Materials, along with some further information on vignette development. All vignettes in this study had a Flesch reading ease score over 60, indicating that they are written in plain English comprehensible to those aged 13 years and above.

Measures

To explore how teacher characteristics related to ratings of the autism vignettes we measured the following variables. Questions eliciting this information were asked after participants had rated all four vignettes.

Personal experience of autism. We asked respondents, "Do you have personal experience of any of the following, e.g., through relatives, colleagues, friends? Please tick all that apply." Participants chose their answer from a list of conditions (anxiety, ADHD, autism, and disruptive behavior).

Received specific autism training. Participants were asked, "Have you received any specific training (e.g., CPD courses) on any of the following since obtaining your primary qualification? Please tick all that apply," choosing

Table 1. Summary of Vignette Content

Vignette type	Word length	Core characteristic 1	Core characteristic 2	Core characteristic 3	Core characteristic 4	Core characteristic 5	Physical health concern	Co-occurring mental health condition
Female autism phenotype	180	Difficulty socializing, (higher friendship interest)▲	Restricted interest (social/animal focused)▲	Camouflage/ Mimicking▲	Autism-related emotional/ behavioral problem▲	Autistic characteristic impacts on relations with teacher	Mild eczema	Anxiety
		"best friends with another girl in the class, Mia, although Chloe does not seem to be friends with any of the other children"	*"Chloe loves meerkats, and has pictures of them over her books, and will often reference them in her creative writing"*	*"Chloe will also copy a lot of Mia's behaviors"*	*"she is a fussy eater and will leave a fair amount of her food every lunchtime"*	*"you are required to put cream on her during the summer months, which Chloe becomes very distressed about"*	*"she suffers from mild eczema"*	*"she is generally quite nervous and will worry a lot about her work"*
Male autism phenotype	195	Difficulty socializing	Restricted interest	Difficulty with change	Autism-related emotional/ behavioral problem	Autistic behavior impacts on relations with teacher	Dietary concerns	Anxiety
		"He tries to join in with the other children but tends to be ignored"	*"if there is any free time in the classroom, Jack will spend it playing with his Harry Potter cards."*	*"He likes the routine of the classroom, but you have noticed that he can struggle moving from playtime back to the classroom"*	*"He has been involved in a couple of arguments and fights with his peers"*	*"you have observed that he responds well to quite strict rules and boundaries"*	*"you have noted that his lunch lacks healthy options like fruit"*	*"he is quite a nervous child who will worry a lot about things going wrong"*
ADHD	193	Difficulties with concentration	Easily distracted	Excess energy	Impulsive	Restless & fidgety	Dietary concerns	Disruptive behavioral disorder
		"He can find it difficult to focus during class"	*"will often distract peers or interrupt you when you are giving instructions"*	*"it is difficult to manage James in the classroom…he prefers to be out of the classroom and engages well in PE"*	*"he can become boisterous with his peers, which has led to other children being hurt accidentally"*	*"will often fidget in his seat"*	*"you have noticed that his lunch lacks healthy options"*	*"It has become difficult to manage James in the classroom and he has become one of the more challenging pupils in the year group"*
Separation anxiety	182	Refusal to go to school	Distress leaving caregiver	Physical anxiety symptoms	Fear of event which would lead to separation	Excessive fear of being alone	Mild eczema	Low mood
		"arrives late to your class every day"	*"you have had to physically coax Becky from her Mum when they enter the classroom"*	*"Becky will often complain of sickness, such as nausea or headaches"*	*"she will refuse to go to the far end of the playground, stating that she is scared of being taken by a stranger near the gates"*	*"she became very tearful at the prospect because she did not want to walk around the school alone"*	*"She suffers from mild eczema"*	*"Becky is often tearful and withdrawn"*

Note: Flesch Reading Ease scores were over 60 for all vignettes, indicating that the content was simple enough for intermediate readers and above.
▲ denotes a core characteristic designed to exemplify the female autism phenotype.

their answers from a list of conditions (anxiety, ADHD, autism, and disruptive behavior).

Number of autistic children worked with as an educator. Participants gave a numeric response to the question, "Approximately how many children with a diagnosis of Autism Spectrum Disorder have you worked with throughout your professional career?" For the purposes of analysis, we divided their responses into four categories that each encompassed approximately 25% of the sample: "0–3 children," "4–7 children," "8–14 children," and "15 or more children."

Procedure

This study was reviewed and approved by the UCL Ethics Committee (12891/001) and is in line with standards for ethical research set out in the Declaration of Helsinki. The experiment was delivered online, using the survey software Qualtrics (Qualtrics, Provo, UT). To avoid biasing responses, respondents were not explicitly told they were participating in an experiment focused on autism and gender. Instead, the study was described as being about child mental health. After completing the seven rating scales for each presented vignette, respondents were asked to complete a series of questions on background demographics and their experience and training as educators. The survey took an average of 17 min to complete.

Pilot

Once developed, the survey was piloted on four primary school educators (two qualified teachers, one teaching assistant, and one SENCO) using cognitive interviewing techniques. Feedback from the pilot confirmed the usability of our vignettes, with respondents reporting that each pupil described was representative of a 7-year-old child. Nonetheless, the feedback led to changes in how the study was presented and the wording of several questions.

Analysis

To test the hypotheses, while accounting for the Balaam's design that included both within-subject (phenotype) and between-subject (child gender) factors, multilevel modeling was used. A model was run with the participant-rated likelihood of the child described having autism as the dependent variable. Also, three models analyzed the support-seeking variables, with the dependent variables being reported likelihood of seeking support from: (a) within the school, (b) an educational psychologist, and (c) a medical or mental health professional, respectively. In each model, child gender (*Hypothesis 1*: "Jack" vs. "Chloe") and vignette type (*Hypothesis 2*: "male autism phenotype" vs. "female autism phenotype") were entered as predictors. We also modeled the interaction between gender and vignette type. For the support-seeking outcome variables, a further analysis was conducted, whereby we controlled for the ratings provided by respondents of the likelihood of the child depicted having a mental health or neurodevelopmental condition (i.e., autism, ADHD, separation anxiety or a disruptive behavioral disorder). This analysis served to examine whether any gender and/or vignette type effects upon the likelihood of respondents seeking support were independent of how likely the respondent rated the child to have a mental health or neurodevelopmental condition. To focus on our hypotheses, data for the distractor vignettes (separation anxiety and ADHD) were not included in the analysis.

We also conducted exploratory analyses, testing variables reflecting educator experiences, to determine whether these predicted ratings given to the male and female phenotype vignettes. The educator variables tested were: (a) experience of autism in personal life; (b) received specific autism training; (c) the reported number of autistic children worked with as an educator. We tested each of these predictors in multiple regression analyses for the male and female autism phenotype vignettes, separately. For each regression, the sex of the vignette presentation ("Jack" vs. "Chloe") was also entered to control for any gender effect. Then, we entered an interaction term between gender and the predictor being tested, to see if any effects were different for vignettes presented as being about "Jack" versus "Chloe."

Results

Sample Characteristics

Of the 289 respondents, the majority (94.1%; n = 272) were female. Participants ranged in age from 20 to 64 years (median = 31.0 years, Interquartile range [IQR] = 33.0). This is broadly in line with the Department for Education school workforce census in 2010, which shows that 86% of primary school teachers in England are female, with 54% aged 39 or younger [DoE, 2011]. Most respondents were qualified teachers (n = 253, 87.5% of sample). The 36 participants (12.5% of the sample) who were not qualified teachers included nine trainee teachers, 16 teaching assistants, and 11 in "other" current or past educational roles in primary schools. For those trained as teachers, the number of years practicing ranged from less than a year to 42 years (median = 6.0, IQR = 9.0). Table 2 shows the amount of experience respondents reporting having with autism, anxiety disorder, and ADHD, based on the number of children currently in their class with these diagnoses, and the number of children with these diagnoses they have worked with

Table 2. Educators' Experience and Training in the Different Mental Health and Neurodevelopmental Conditions

	Conditions		
	Autism	Anxiety disorder	ADHD
Number of children with diagnosis currently in class			
N (%)	234 (81.0)	225 (77.9)	232 (80.3)
0	106 (36.7)	166 (57.4)	147 (50.9)
1	75 (26.0)	38 (13.1)	65 (22.5)
≥2	53 (18.3)	21 (7.3)	20 (6.9)
Mean (*SD*)	1.03 (1.5)	0.45 (1.0)	0.62 (1.4)
Number of children with diagnosis throughout career			
N (%)	283 (98.0)	279 (96.5)	279 (96.5)
0	8 (2.8)	90 (31.1)	34 (11.8)
1	11 (3.8)	58 (20.1)	37 (12.8)
2	23 (8.0)	36 (12.5)	52 (18.0)
3–5	89 (30.8)	58 (20.1)	74 (25.6)
6–10	69 (23.9)	18 (6.2)	52 (18.0)
11–15	30 (10.4)	5 (2.0)	15 (5.2)
≥16	53 (18.3)	14 (4.8)	15 (5.2)
Mean (*SD*)	9.58 (8.5)	3.35 (5.9)	5.15 (5.9)
Professional experience of neurodevelopmental / mental health condition prior to training[a]			
N (%)	125 (43.3)	40 (13.8)	87 (30.1)
Personal experience of neurodevelopmental / mental health condition[a]			
N (%)	119 (41.2)	128 (44.3)	68 (23.5)
Training received since qualification[a]			
N (%)	158 (54.7)	45 (15.6)	65 (22.5)

Abbreviation: ADHD, attention-deficit/hyperactivity disorder.
[a]Number of respondents who reported "yes" to these questions.

throughout their career, in addition to any training received in these conditions.

Hypothesis Testing

For the autism vignettes, the scores expressing the likelihood, estimated by participants, of the described child being autistic, and the scores expressing the likelihood of seeking support for that child, are presented in Table 3. In the current study, there was no relationship between the randomized order in which the autism vignettes were presented (i.e., first, second, third, or fourth) and participant ratings of autism likelihood (*P*s > 0.296).

Likelihood of having an autism diagnosis. As can be seen from Table 4, there was a main effect of vignette phenotype, gender, and a significant interaction effect between these two factors. For the vignette phenotype, being presented with a male phenotype resulted in an average 14.53 increase (on a scale ranging from 0 to 100) in likelihood rating in comparison to the female phenotype, controlling for the other predictors in the model. Similarly, for gender, compared to the female gender, being presented with a male gender resulted in an average 10.79 increase in likelihood rating, controlling for the other predictors.

The significant interaction showed that the effect of gender was larger for the female phenotype in comparison to the male. That is, for the male phenotype, the average likelihood ratings between male ("Jack") and female ("Chloe") gender were similar (Z = 0.5, $P = 0.614$) while there was a significant difference between the average likelihood ratings for the female phenotype for male gender ($M = 66.1$, $SD = 23.3$) and female gender ($M = 54.9$, $SD = 26.9$) (Z = 4.13, $P < 0.001$) (see Fig. 1). These findings suggest that there is a bias against the vignettes presenting females on the autism spectrum generally, but only if they present with the female phenotype.

Likelihood of seeking support. Next, as presented in Table 5, we analyzed the three "support seeking" outcome variables, without controlling for the estimations of each mental health or neurodevelopmental difficulty (i.e., autism, ADHD, anxiety, and disruptive behavior). There was a main effect of vignette phenotype for all forms of support seeking, with the male phenotype vignette resulting in higher ratings than the female phenotype for seeking support from within the school

Table 3. Descriptive Statistics for Main Effect of Vignette Phenotype, Gender, and Interaction for All Dependent Variables

	Vignette phenotype		Gender name		Interaction			
	Male P	Female P	Male N	Female N	Male P Male N	Male P Female N	Female P Male N	Female P Female N
Likelihood[a]								
Mean	70.24	60.44	68.32	62.45	70.61	69.89	66.08	54.85
SD	20.11	25.72	21.44	25.20	19.13	21.06	23.33	26.83
95% CI	67.81–72.57	57.46–63.42	65.82–70.82	59.55–65.34	67.43–73.80	66.47–73.31	62.23–69.92	50.44–59.25
N	289	289	285	293	141	148	144	145
School[b]								
Mean	75.16	68.42	74.24	69.42	75.78	74.57	72.72	64.15
SD	23.44	25.51	22.25	26.71	22.34	24.50	22.13	27.90
95% CI	72.45–77.88	65.47–71.38	71.64–76.83	66.35–72.49	72.06–79.50	70.59–78.55	69.08–76.37	59.57–68.73
N	289	289	285	293	141	148	144	145
Psychologist[b]								
Mean	51.70	48.10	52.25	47.61	50.06	53.25	54.39	41.85
SD	28.10	29.06	28.51	28.59	28.78	27.45	28.17	28.67
95% CI	48.44–54.95	44.73–51.46	48.93–55.57	44.32–50.89	45.27–54.86	48.79–57.71	49.75–59.03	37.14–46.55
N	289	289	285	293	141	148	144	145
Medical[b]								
Mean	48.92	47.78	50.30	46.45	47.57	50.21	52.98	42.61
SD	27.98	29.74	29.14	28.50	29.06	26.95	29.07	29.60
95% CI	45.68–52.16	44.34–51.22	46.90–53.70	43.17–49.73	42.73–52.41	45.83–54.59	48.19–57.77	37.76–47.47
N	289	289	285	293	141	148	144	145

Abbreviations: *SD*, standard deviation; CI, confidence interval; P, phenotype; N, name.
[a]Estimated likelihood of a child having autism, scale 0–100.
[b]Estimated likelihood of seeking support for the child from: within school/educational psychologist/medical professional.

Table 4. Coefficients and Significance Levels for Estimated Likelihood of Child Having an Autism Diagnosis

	Coefficient	*SE*	*Z*	Sig.	95% CI
Fixed effects					
Constant	55.07	1.86	29.53	$P < 0.001$***	51.41–58.72
Male phenotype	14.53	2.50	5.84	$P < 0.001$***	9.65–19.41
Male name	10.79	2.61	4.13	$P < 0.001$***	5.67–15.91
Interaction	−9.47	3.74	−2.53	$P = 0.011$*	−16.79 to −2.15
Random effects					
Between subjects *SD* ($\sqrt{\psi}$)	10.50	1.48	–	–	7.97–13.84
Within subjects *SD* ($\sqrt{\theta}$)	20.13	0.84	–	–	18.55–21.84
Interclass correlation coefficient	0.21	0.06			0.12–0.34

Note: Significant *$P < 0.05$, ***$P < 0.001$.

(coefficient = 9.38, $P < 0.001$), from an educational psychologist (Coefficient = 10.92, $P < 0.001$), and from a medical or mental health professional (coefficient = 6.42, $P = 0.011$).

Similarly, there was a main effect of gender for all forms of support seeking; the male gender resulted in higher likelihood ratings than the female gender for seeking support from within the school (coefficient = 7.73, $P = 0.003$), from an educational psychologist (coefficient = 12.23, $P < 0.001$), and from a medical professional (coefficient = 7.39, $P = 0.008$). Furthermore, there was a significant interaction between vignette phenotype and gender for ratings of support seeking from an educational psychologist (coefficient = −14.74, $P < 0.001$), and from a medical professional (coefficient = −10.67, $P < 0.001$). We examine this interaction in detail below.

When we repeated these analyses while controlling for the likelihood ratings for mental health and neurodevelopmental difficulties (i.e., autism, ADHD, anxiety, and disruptive behavior), only a few of the main effects and interactions remained significant, as is shown in Table 5. There was no longer the main effect of vignette phenotype for any of the forms of support seeking, indicating that the male presentation does not directly increase the likelihood of seeking support. Instead, these results are due to respondents indicating higher estimations for the presence of a mental health or neurodevelopmental difficulty for the male presentation.

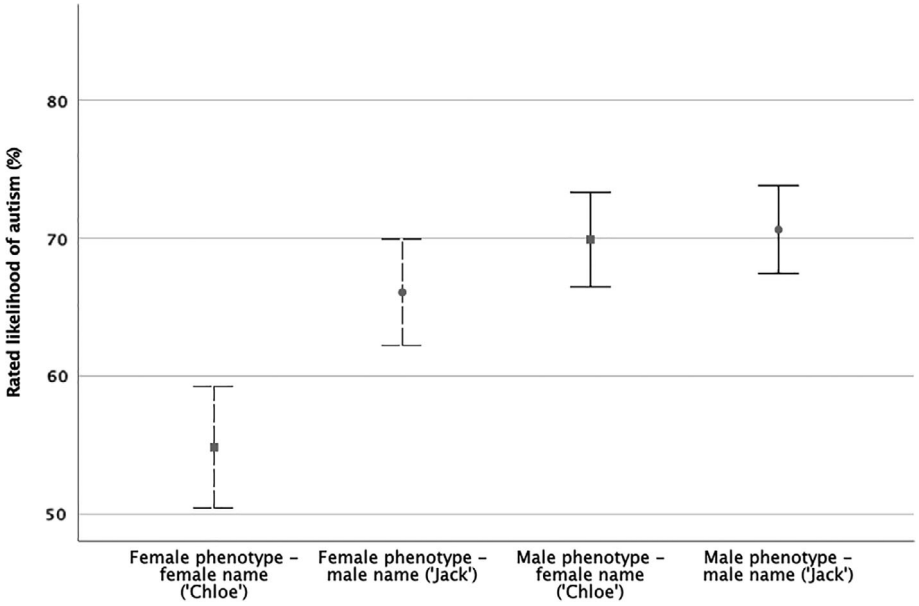

Figure 1. Rated likelihood of autism diagnosis as a function of vignette phenotype and gender (mean, 95% CI).

Table 5. Coefficients and Significance Levels for Estimated Likelihood of Seeking Support for Child From Three Different Sources

	Noncontrolled					Controlled				
	Coefficient	*SE*	*Z*	Sig.	95% CI	Coefficient	*SE*	*Z*	Sig.	95% CI
School										
Constant	64.57	1.92	33.61	$P < 0.001$***	60.81–68.34	21.86	3.17	6.89	$P < 0.001$***	15.64–28.08
Male phenotype	9.38	2.38	3.93	$P < 0.001$***	4.70–14.05	3.10	2.03	1.53	$P = 0.13$	−0.88–7.08
Male name	7.73	2.58	3.00	$P = 0.003$**	2.57–12.78	2.41	2.09	1.15	$P = 0.25$	−1.69–6.51
Interaction	−5.24	3.72	−1.41	$P = 0.16$	−12.53–2.06	−0.94	2.99	−0.31	$P = 0.75$	−6.79–4.92
Psychologist										
Constant	42.00	2.16	19.44	$P < 0.001$***	37.77–46.24	7.28	3.95	1.84	$P = 0.07$	−0.46–15.02
Male phenotype	10.92	2.54	4.30	$P < 0.001$***	5.94–15.89	4.07	2.44	1.67	$P = 0.09$	−0.72–8.86
Male name	12.23	2.78	4.40	$P < 0.001$***	6.78–17.68	7.71	2.54	3.04	$P = 0.002$**	2.74–12.68
Interaction	−14.74	4.03	−3.66	$P < 0.001$***	−22.64–−6.85	−11.64	3.63	−3.21	$P = 0.001$**	−18.75–−4.53
Medical/mental health										
Constant	44.10	2.18	20.24	$P < 0.001$***	39.83–48.37	8.38	4.08	2.05	$P = 0.04$*	0.38–16.38
Male phenotype	6.42	2.52	2.55	$P = 0.011$*	1.48–11.37	0.84	2.50	0.34	$P = 0.74$	−4.07–5.75
Male name	7.39	2.78	2.66	$P = 0.008$**	1.95–12.83	3.90	2.60	1.50	$P = 0.13$	−1.19–8.99
Interaction	−10.67	4.02	−2.65	$P < 0.001$***	39.83–48.37	−8.41	3.71	−2.26	$P = 0.02$*	−15.69–1.13

Note: Significant *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.

Similarly, when the mental health or neurodevelopmental difficulty likelihood ratings were controlled for, there was no main effect of gender for two forms of support seeking: from within the school or from a medical/mental health professional. Interestingly, there was still a significant main effect of gender for seeking support from an educational psychologist (coefficient = 7.71, $P = 0.002$), suggesting that if the child depicted in the vignette was male, regardless of how likely the respondent thought that the child had a mental health or neurodevelopmental difficulty, they rated a higher likelihood of seeking support from an educational psychologist than if the child depicted was female.

The interaction effects remained significant even after controlling for the estimations of each mental health or neurodevelopmental difficulty. A significant interaction was found between vignette phenotype and gender for ratings of support seeking from an educational

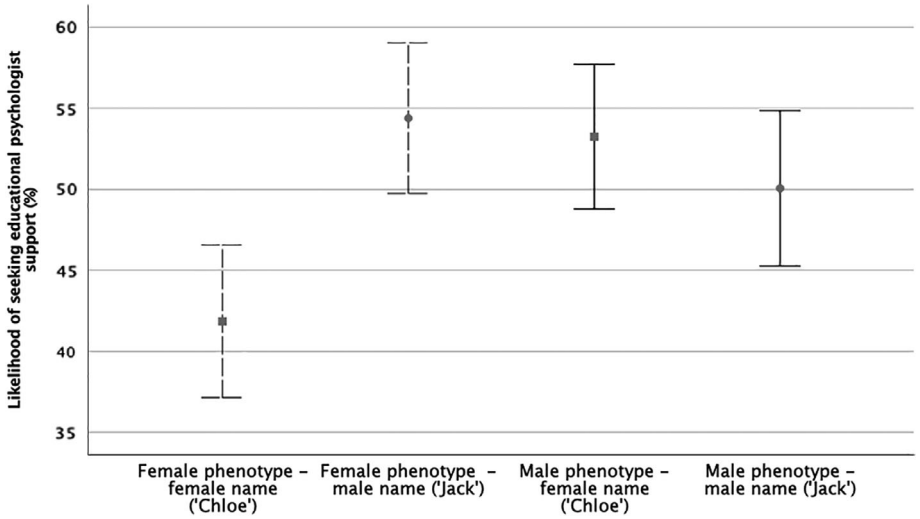

Figure 2. Likelihood of seeking support from an educational psychologist by vignette phenotype and gender (mean, 95% CI).

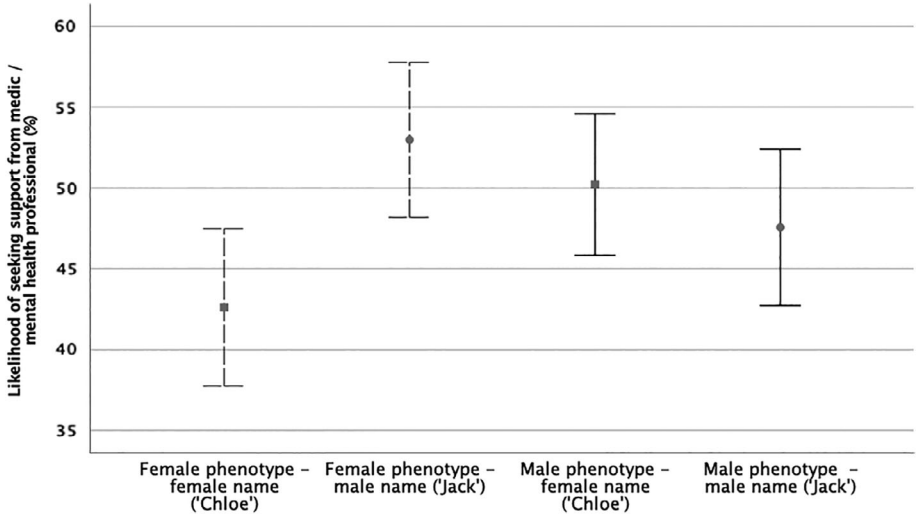

Figure 3. Likelihood of seeking support from a medic or mental health professional by vignette phenotype and gender (mean, 95% CI).

psychologist (coefficient = −11.64, $P = 0.001$) and from a medical professional (coefficient = −8.41, $P = 0.02$). For both of these forms of support, the interaction showed that for both the male and female phenotypes, the corresponding gender resulted in a lower likelihood of seeking support. This can be seen more clearly in Figures 2 and 3.

The results of exploratory analyses investigating whether educator experiences predicted sensitivity to the presentations described in the autism vignettes are presented in Table 6. For the male autism phenotype vignettes, having worked with four or more autistic children (as opposed to having worked with three or fewer) was predictive of sensitivity to autism. Those with personal experience of autism and those with the most experience of working with autistic children (15 or more in career) were most sensitive to the female autism phenotype vignette.

Discussion

In accordance with our hypotheses, when presented with vignettes depicting fictional children, primary school educational staffs were more likely to identify autism in males than females, and were more sensitive to the male phenotype in comparison to the female phenotype of autism. Furthermore, in this vignette study, we found that the bias against girls exists for those showing the female phenotype, but not for girls with the male (i.e., more conventional) autism phenotype. These findings

Table 6. Educator's Training and Experience As a Predictor of Rating of Autism Vignettes

	Male phenotype (N = 289)		Female phenotype (N = 289)	
	B [95% CI]	Significance	B [95% CI]	Significance
Experience of autism in personal life				
Block 1				
Constant	69.65 [65.80, 73.50]	$P < 0.001$	62.13 [57.47, 66.79]	$P < 0.001$
Female name (Chloë vs. Jack)	−0.75 [−5.42, 3.91]	$P = 0.751$	−11.55 [−17.27, −5.82]	$P < 0.001$
Yes—has personal experience of autism	2.39 [−2.35, 7.12]	$P = 0.323$	9.98 [4.17, 15.80]	$P < 0.001$
Block 2				
Interaction: Personal experience by female name	1.02 [−8.48, 10.51]	$P = 0.833$	2.64 [−9.01, 14.29]	$P = .656$
Received specific training on autism				
Block 1				
Constant	69.54 [65.39, 73.69]	$P < 0.001$	66.49 [61.28, 71.86]	$P < 0.001$
Female name (Chloë vs. Jack)	−0.82 [−5.49, 3.85]	$P = 0.730$	−11.28 [−17.12, −5.43]	$P < 0.001$
Yes—received autism training	2.05 [−2.64, 6.74]	$P = 0.392$	−0.72 [−6.59, 5.16]	$P = 0.810$
Block 2				
Interaction: Autism training by a female name	7.24 [−2.1, 16.61]	$P = 0.129$	−7.40 [−19.14, 4.34]	$P = 0.216$
Number of children with autism worked within an educational career[a]				
Block 1				
Constant	62.77 [57.96, 67.59]	$P < 0.001$	63.79 [57.45, 70.13]	$P < 0.001$
Female name (Chloë vs. Jack)	−1.37 [−5.85, 3.12]	$P = 0.549$	−11.21 [−17.04, −5.37]	$P < 0.001$
4–6 children (reference 0–3)	9.53 [3.35, 15.70]	$P = 0.003$	−0.004 [−8.05, 8.04]	$P = 0.999$
7–14 children (reference 0–3)	9.57 [3.17, 15.98]	$P = 0.004$	0.441 [−7.9, 8.79]	$P = 0.917$
15 children or more (reference 0–3)	15.86 [9.72, 22.01]	$P < 0.001$	9.51 [1.49, 17.52]	$P = 0.020$
Block 2				
Interaction: 4–6 children by female name	5.03 [−7.35, 17.41]	$P = 0.425$	−12.95 [−29.00, 3.10]	$P = 0.113$
7–14 children interaction by female name	5.60 [−7.24, 18.44]	$P = 0.391$	0.541 [−16.11, 17.19]	$P = 0.949$
15 children or more by female name	−3.5 [−15.81, 8.81]	$P = 0.576$	3.18 [−12.82, 19.17]	$P = 0.696$

[a]N = 283.

provide insight into the diagnostic bias against females on the autism spectrum.

Recognition of Autism in the Vignettes

Research investigating the discrepancy in prevalence rates of diagnosed autism in males and females has suggested that there is a bias against females with the condition [Lai et al., 2015; Geelhand et al., 2019]. Our findings support this suggestion. Furthermore, our study helps elucidate one potential source of this bias, namely the decision making of educators. To our knowledge, this is the first study that has attempted to test formally the possibility that primary school educators, who are often key gatekeepers for autism referral and assessment, show a gender bias in identifying autistic children [cf. Bargiela et al., 2016]. Our results suggest two possible ways in which this bias might occur. First, by providing respondents with identical vignettes apart from the gender described, and finding that girls were significantly less likely to have their autism recognized; this study directly demonstrates a bias against girls based solely on gender. This result is in line with findings concerning perceptions of autistic characteristics of people in the general

population [Geelhand et al., 2019]. It is possible that this is due to an expectancy bias among respondents. As discussed by Kreiser and White [2014], when a condition occurs more often in one gender, or the features are more stereotypical of one gender, clinicians can often exhibit a diagnostic bias in line with their expectations. The prevalence rates previously discussed and popular theories such as the "Extreme Male Brain," in which it is argued that males are biologically more likely to develop autism [Baron-Cohen, 2002], may have contributed to expectations that an individual girl with autistic symptoms is less likely to be autistic. As a result, this stereotype may have shaped participants' responses such that educational professionals were influenced by their expectation that autism would be less likely to be present when responding to a female-name vignette.

Second, by further demonstrating that the female autism phenotype is less recognized than the male phenotype this study shows that the female presentation itself is another source of the diagnostic bias against autistic females. This accords with the findings of Bargiela et al. [2016], in which late-diagnosed autistic women reported that their delay in receiving a diagnosis was partly due to professionals, including teachers, having an insufficient understanding of how autism presents in females.

Based on previous qualitative [Bargiela et al., 2016] and experimental [Geelhand et al., 2019] findings we predicted a gender stereotyping effect (*Hypothesis 1*): we anticipated that educators would rate a male child as more likely to be autistic than a female child, even if both children are described in a vignette as having identical autism-related characteristics. To our surprise, we found only partial support for this hypothesis, since there was an interaction, suggesting that a gender stereotyping effect operates for the female phenotype, but not the male phenotype. This finding is, to our knowledge, new, and adds nuance to our understanding of gender-based diagnostic biases for autism. It is important, given that females are most likely to express this phenotype. Similarly, for female phenotype vignettes with a female protagonist, educational staff indicated that they were actually "unlikely" to seek support from an educational psychologist or a medical professional, suggesting that if these were real children, their school would not promote them receiving an assessment with a professional who could provide a diagnosis. This could contribute to the observed discrepancy in prevalence rates of diagnosed autism in males and females.

Support Seeking and the Influence of Gender Expectations

In regard to support seeking, we found that educators expressed less likelihood of seeking support for female, compared to male children; and for those expressing the female, rather than the male, autism phenotype. When we controlled for the educators' estimation of whether the child had autism, ADHD, anxiety, or disruptive behavior, the main effects of female gender and female autism phenotype on seeking support were no longer influential. This suggests that any gender effects on support-seeking intentions we observed were driven by the under-recognition of autism in the females presented in these vignettes.

However, some interaction effects with respect to support seeking persisted, even when we controlled for estimations of mental health and neurodevelopmental difficulties. Respondents expressed a greater likelihood of seeking support for children in vignettes in which there was a mismatch between the gender and phenotype. Arguably, this reflects sociocultural expectations. Research investigating gender stereotypes has shown that educators often expect boys to be more aggressive or assertive, while they expect girls to be passive and easier to manage [Gray & Leith, 2004]. For example, Kokkinos, Panayiotou, and Davazoglou [2004] examined the effects of pupil gender on teachers' perceptions of the seriousness of various unacceptable behaviors and found that teachers rated behaviors such as being sensitive, crying, and being easily disappointed, as more serious in boys, while they rated behaviors such as being verbally or physically abusive, as more serious in girls. In line with these findings, respondents in this study may not expect a male child to be passive and anxious, as depicted in the female phenotype vignette, and similarly may not expect a female child to be aggressive with peers, as depicted in the male phenotype vignette.

Influences on Recognition of Autism

Our exploratory analyses suggest that specific autism training received by educators may have little effect on their ability to recognize autism, at least as presented in our vignettes. Rather, variables relating to the personal contact with autistic people were the best predictors of autism recognition. Even having fairly limited experience of working with autistic children, (four or more in career) predicted sensitivity to the male autism phenotype. For the female phenotype, it seems that higher levels of experience were needed to impact upon recognition, given that high experience (15 or more children worked with) and personal experience of autism were significant predictors. These must be recognized as preliminary findings, based on rather basic measures of educator training and experience. Nevertheless, it is notable that our findings fit with those for another profession that is a gatekeeper for an autism assessment, family doctors, who report relying on personal experience of autism to inform their professional practice [Unigwe et al., 2017]. To build on our preliminary findings, it would be important in the

future to characterize training experiences in much more detail, to see if the amount and type of training received has an impact. Nevertheless, our current analyses suggest the following hypotheses for future testing: (a) fostering personal contact with autistic people may help educators become better at recognizing autism in the classroom; and (b) current training available to UK educators on autism may need reform.

Limitations

This study has several limitations. First, in order to control and manipulate variables for this experiment, we used depictions of hypothetical children, rather than real-life examples; and we studied educator's estimations of how they (the educators) would behave rather than their actual behavior. Therefore, we cannot be certain that these findings reflect what actually happens in real school settings, nor if they are a true reflection of educational professionals' behavior. That said, this level of control may well have *underestimated* the bias reported herein. Although we were careful to conceal the autism-focused nature of the study, respondents were still asked to rate the likelihood of a child having a mental health diagnosis, and therefore the respondents were forced to look for potential signs and consider the possibility. Yet, in real life, often faced with around 30 children in a classroom, it is unlikely that educational professionals will be looking as closely, and the possibility may be less likely to cross their minds. Indeed, it has been shown that as the size of classes increases, teachers display less knowledge of their pupils and find it harder to detect problems or specific needs [Blatchford, Russell, & Brown, 2009]. As such, it is possible that, in reality, primary educational staff may display a higher level of bias than our study detected, due to a combination of the subtlety of the female autism phenotype and the difficulty noticing individual pupil needs in a class of children.

Second, in this first study of its kind, we took a binary view of gender, which may not reflect experiences of those autistic people who identify with a gender different to the one they were assigned at birth, or who take a non-binary view of gender. Future research on gender bias in the recognition of autism should incorporate gender diversity perspectives and reflect upon the binary gender framework, which is prevalent but rapidly evolving in many modern societies [Strang et al., 2018].

Third, our sample of educators had diverse roles: most (87.5%) were qualified teachers, but some were teaching assistants or teachers in training. Also, there was variability in terms of our participants' level of experience. Therefore, it should be recognized that these findings do not simply apply to teachers, but rather to the broader category of educators who participated. The level of experience and teaching role was controlled for by our randomized design. Also, the heterogeneity of our sample allowed us to explore whether variability in experience and training was predictive of sensitivity to female and male-typical autism presentations.

Fourth, our design would have been enhanced where we have included a qualitative element to the experiment, which could have elucidated the assumptions and knowledge gaps that could underpin our participants' responses in the experiment. This would aid in informing the increased training of educational staff on autism, which is being regarded as a necessity by those with autism and their families [Crane et al., 2018].

Finally, it is important to note that the sample was limited to primary school educational staff, and thus our conclusions cannot be generalized to other populations. Primary school staff are not the only gatekeepers to diagnosis, and it is unclear whether others, such as family doctors or those in later education, show a similar bias. Indeed, late-diagnosed women and those unsatisfied with the diagnostic process, have noted that family doctors (in the UK GPs) could display insufficient autism awareness, and might fail to recognize the subtler symptoms of the condition [Bargiela et al., 2016; Crane et al., 2018], and UK GPs themselves report that they lack confidence in recognizing and supporting their autistic patients [Unigwe et al., 2017]. Together, these findings suggest that primary care physicians are another important population in which to investigate the diagnostic bias against females. Furthermore, all the children in our vignettes were 7 years old. It would be valuable in the future to test sensitivity to autism across the lifespan, especially since gender differences in autistic characteristics change with time [Mandy, Pellicano, St Pourcain, Skuse, & Heron, 2018].

Conclusions

This study is a step toward understanding what drives the diagnostic bias against autistic girls and women. Our findings indicated that both the female presentation of autism and the female gender can result in an increased likelihood of the condition going unrecognized by primary school educational staff. These results suggest the value of additional training for primary school educational staff to enhance knowledge of autism in girls and thereby improve recognition.

Acknowledgments

The authors would like to thank the educators who contributed their time to participate in this project.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Appendix S1: Supporting Information