Autism and transgender identity: Implications for depression and anxiety

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ABSTRACT

Autistic traits are over-represented in transgender populations, and gender variance is high in autistic individuals. Furthermore, some evidence suggests that the autism/transgender overlap is limited to individuals sex assigned female. Few studies, however, have investigated the impact of this overlap on mental health. This study therefore sought to investigate whether the autism/transgender overlap confers an increased risk of depression or anxiety. An online study of 727 individuals revealed a substantial overlap between transgender identity and autism, with increased autistic traits found in trans men compared to trans women. Depression and anxiety were highest in autistic-trans individuals, but no superadditive effect was observed. The implications of these findings are discussed in relation to the wider healthcare system.

1. Introduction

Autism diagnosis and autistic traits are more common in the transgender population than in the wider (cisgender; see below), population (e.g., de Vries, Noens, Cohen-Kettenis, van Berckelaer-Onnes, & Doreleijers, 2010). However, this overlap is not well understood nor appreciated. Gatekeeping of mental health and transition-related services is a major issue for the transgender community, and particularly for those with autism (Strang et al., 2018). This is exemplified by a number of high-profile cases involving autistic transgender individuals, and transgender individuals with other developmental disorders or mental health conditions, who have faced 'numerous roadblocks' when seeking transition related medical care (White, 2016; ASAN joint statement, 2016). Better understanding of the needs of autistic individuals who identify as transgender is therefore of crucial importance.

Transgender is an umbrella term for people whose gender identity does not match their sex assigned at birth (hereafter 'trans') (Gay & Lesbian Alliance Against Defamation (GLAAD), n.d.). People who identify under this banner may also identify as genderqueer, non-binary or genderfluid, meaning that their gender identity does not fit neatly into the binary categories of male or female. In this study, when referring to trans individuals, we are referring to those who identify with a binary gender (i.e. man or woman) which is different from their sex assigned at birth, and not to the umbrella term which includes those who do not identify as trans but do identify as gender variant. Gender discordance is defined as a discrepancy between sex assigned at birth and gender identity, with the term gender identity variance (hereafter 'gender variance') used to denote a spectrum of gender-discordant phenomena (Adelson,

2012; Gender Identity Research & Education Society (GIRES), 2014). Trans men are individuals whose sex assigned at birth was female and identify as male, whereas trans women's sex assigned at birth was male but they identify as female. Cisgender refers to those whose gender identity matches their sex assigned at birth (hereafter 'cis').

1.1. Overlap between trans identity and autism

Anecdotally, clinicians and those involved in the trans and autistic communities have noted overlap between autism and gender variance (e.g., Seaman, 2016). Case studies have identified this both in children and in adults, sex assigned male and female at birth (Gallucci, Hackerman, & Schmidt, 2005; Kraemer, Delsignore, Gundelfinger, Schnyder, & Hepp, 2005; Landen & Rasmussen, 1997; Mukaddes, 2002). Consistently, studies investigating the incidence of autistic traits and autism diagnosis in individuals referred to gender identity clinics suggest that autistic traits are higher in those who are gender variant than in cisgender populations. For example, de Vries et al. (2010) observed that the incidence of autism diagnosis (confirmed using the Diagnostic Interview for Social and Communication Disorders) in a sample of children and adolescents was 7.8%, around 10 times higher than the 0.6–1% prevalence in the general population. In adults referred to gender identity clinics, Pasterski, Gilligan and Curtis (2014) also observed that the prevalence of clinically significant autistic traits (confirmed using Autism-Spectrum Quotient (AQ; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001)) was 5.5%. A number of other studies have reported a greater incidence of autistic traits in adolescents and children identified as gender dysphoric (e.g., Skagerberg, Di Ceglie, & Carmichael, 2015; VanderLaan, Leef, Wood, Hughes, & Zucker, 2015) with recent research reporting an even higher prevalence of autistic traits in gender dysphoric children (e.g., 26%; Kaltiala-Heino, Sumia, Työläjärvi, & Lindberg, 2015; Shumer, Reisner, Edwards-Leeper, & Tishelman, 2016; van der Miesen, Hurley, Bal, & de Vries, 2018; van der Miesen, de Vries, Steensma, & Hartman, 2018).

Despite consistent evidence, it is notable that in these studies the incidence of autistic traits was assessed among gender-dysphoric individuals. Whilst a perfectly valid method, this recruitment strategy is likely to exclude trans individuals who have not been diagnosed with gender dysphoria and, given known difficulties accessing gender identity clinics (NHS England, 2015), may limit our understanding of the overlap between transgender identity and autism more broadly. More recent studies have therefore begun to examine gender variance in autistic individuals or the overlap between autism and gender variance in large internet samples. Consistent with research assessing autistic traits in gender variant samples, these studies suggest that the incidence of trans identity (in Strang et al., 2014 defined as 'a wish to be the other gender') is higher in children with a diagnosis of autism (5.4%) than children with ADHD (4.8%), or neurodevelopmental disorders such as epilepsy or neurofibromatosis 1 (1.7%), or typically developing children (0-0.7%) (Strang et al., 2014). Similar findings have been reported in samples of children, adolescents and adults recruited via clinics or internet samples (e.g., Janssen, Huang, & Duncan, 2016; Nabbijohn et al., 2019; Dewinter, De Graaf, & Begeer, 2017; Walsh, Krabbendam, Dewinter, & Begeer, 2018). For example, the results of one online survey of adolescents and adults with autism suggested that 22% of females and 8% of males reported some feelings of gender variance (Dewinter et al., 2017; Walsh et al., 2018). Whilst feelings of gender variance were not assessed in the control group, for females this incidence was higher than previous reports in the general population (e.g., Kuyper & Wijsen, 2014). These data mirror findings in adolescents and adults recruited via internet samples and gender identity clinics, where heightened autistic traits are often observed in those identifying as trans (e.g., Strauss et al., 2017), particularly as trans men (Jones et al., 2012; see following section).

This evidence indicates overlap between trans identity and autism; autistic traits are higher in those identifying as gender variant and gender variance is higher in those with autism. However, as most of this research has focused on adolescents and children, particularly those recruited from gender identity clinics, further research is required to understand the overlap between autism and gender identity in adulthood, and in individuals not diagnosed with gender dysphoria.

1.2. Trans identity in autism: trans men vs. trans women

Within the small amount of research assessing the overlap between autism and trans identity, it has been suggested that autism and heightened autistic traits are more likely to be observed in trans men than trans women (Dewinter et al., 2017; George & Stokes, 2017; Jones et al., 2012). This conjecture is consistent with the Extreme Male Brain (EMB) theory of autism (Baron-Cohen & Hammer, 1997). The EMB theory states that autistic individuals display an extreme of the typical male pattern of cognition and behaviour. As an explanation for the overlap between autism and trans identity, it has been argued that autistic females may identify more readily with the other sex, thus resulting in higher autistic traits in trans men. For example, those sex assigned female at birth with autism show masculinsation through the choice of toys that don't require play (Knickmeyer, Wheelwright, & Baron-Cohen, 2008) and report higher rates of tomboyism (Ingudomnukul, Baron-Cohen, Wheelwright, & Knickmeyer, 2007). It has been argued that females with autism may therefore feel like they do not fit into a neurotypical female peer group, which may result in feelings of gender dysphoria. Consistent with this idea, Jones et al. (2012) observed that trans men had significantly higher scores on the Autism-Spectrum Quotient (AQ) than cis women despite having the same sex assigned at birth. In individuals with autism, further support comes from Dewinter et al. (2017) who found that more autistic females displayed feelings of gender variance than autistic males. By way of an explanation, Jones et al. (2012) suggest that increased autistic traits in trans men made them less able to assimilate to a female peer group, and instead they gravitated towards the male group. This assertion is consistent with more recent findings that autistic individuals sex assigned female had lower social affiliation with their gender group than autistic individuals sex assigned male and individuals sex assigned female without a diagnosis of autism (Cooper, Smith, & Russell, 2018).

However, other studies do not support the proposal that autism and autistic traits are increased in trans men compared to trans women (see van der Miesen, Hurley, & de Vries, 2016). For example, the opposite pattern of results was reported by de Vries et al.

(2010) who found that in a sample of individuals referred to a gender identity clinic trans women were more likely to be subsequently diagnosed with autism. Likewise, many studies report no sex differences in autistic traits in individuals with gender dysphoria (e.g., Pasterski et al., 2014; Strang et al., 2014; Skagerberg et al., 2015). Finally, in a study of trans and genderqueer individuals, Kristensen and Broome (2015) observed that individuals who identified as genderqueer or non-binary showed the highest rates of autistic traits assessed by the AQ-10 (Allison, Auyeung, & Baron-Cohen, 2012). More recently Walsh et al. (2018) also found that individuals with autism were more likely to endorse non-binary gender identities than trans identities. This is inconsistent with the proposal that autistic traits are higher in trans men and the EMB theory, which would predict a progressive increase in autistic traits from female identities through non-binary identities with a peak at male identities. Therefore, it is currently unclear whether elevated autistic traits are observed across all transgender individuals or are a unique characteristic of trans men specifically.

1.3. Impact of autism/trans overlap: mental health

Whilst much research has focused on the overlap between trans identity and autism, to our knowledge there has been little research on the impact of this overlap on mental health. However, there is reason to believe this overlap may confer an increased risk of common mental health problems such as depression and anxiety. Indeed, numerous studies report higher rates of depression and anxiety in the trans population than in the general (e.g. Marshall, Claes, Bouman, Witcomb, & Arcelus, 2016), or LGB (lesbian, gay and bisexual) population (e.g., Warren, Smalley, & Barefoot, 2016). Similarly, depression and anxiety are the most common co-morbidities in autism (e.g. Hollocks, Lerh, Magiati, Meiser-Stedman, & Brugha, 2018).

To our knowledge very few studies have assessed the impact of this overlap on mental health. Strang et al. (2014) investigated whether trans autistic children experienced more depression and anxiety than cis autistic children, observing no significant difference in depression and anxiety scores. In a sample of adolescents and adults with autism, however, van der Miesen, Hurley et al. (2018) reported that those with autism who also endorsed the gender item ('I wish to be of the opposite sex') reported increased anxiety and greater levels of depression. Furthermore, George and Stokes (2018) reported that reaching the cut-off for gender dysphoria (assessed using the gender-identity/gender-dysphoria questionnaire for adolescents and adults) increased the depression, anxiety and stress observed in both autistic and non-autistic individuals in a sample of adolescents and adults. However, although depression, anxiety and stress were highest in individuals who were diagnosed with autism and met cut off for gender dysphoria, no interaction was observed. Importantly, however, as the overlap between autism and gender dysphoria, not self-identified trans identity, was assessed, it is difficult to conclude *a priori* that these results would apply to the larger trans community who may self-identify as transgender but not meet criteria for gender dysphoria (Drescher & Pula, 2019). Additionally, as measures of gender dysphoria presumably capture more extreme aspects of gender variance than self-identification as transgender, using gender dysphoria to index trans identity may inflate or deflate the additive effect on mental health outcomes; for example, if there is a linear relationship between increasing gender variance and depression and anxiety it is possible that individuals who meet criteria for gender dysphoria may exhibit greater rates of depression and anxiety than self-identified trans individuals. Conversely, rates of depression and anxiety may be higher in individuals who self-identify as transgender than those who meet cut off for gender dysphoria, as individuals meeting cut-off may be more able to access mental health and transition-related services.

Of course, a potential reason for any discrepancy across child and adult samples that have utilised cisgender control groups (e.g., Strang et al., 2014; George & Stokes, 2018) may be that depression and anxiety become a larger issue for autistic-trans individuals as they become adults and further experience the difficulties and stigma attached to being trans and autistic. Having a diagnosis of autism can prevent trans individuals from accessing support, as reported in high profile cases of individuals who have been prevented from transitioning due to a lack of understanding of autism (White, 2016; ASAN joint statement, 2016). The pathologizing of the autism/trans overlap led some researchers and clinicians to see trans identity as a symptom of an individual's autism; a result of fixation with their gender (White, 2016). This may prevent individuals from being treated in gender dysphoria clinics, and delay transitioning for those who want to. It is indeed possible that being prevented from transitioning due to an autism diagnosis could cause increased levels of depression and anxiety. Negative experiences with clinicians may also prevent autistic-trans individuals from accessing mental health care. Given that there is extensive evidence for an association between autism and trans identity and a higher prevalence of depression and anxiety in both autistic and trans individuals it is crucial to confirm whether this overlap does confer a greater risk of depression and anxiety in adults.

1.4. Current study and hypotheses

The present study examined the overlap between trans identity and autism in a large sample of adults using an online questionnaire assessing autistic traits, gender identity, depression and anxiety. Previous studies investigating the overlap between autism and trans identity have mostly focused on children and adolescents, with much research conducted in gender identity clinics assessing rates of autism among gender dysphoric children. This is problematic because it conflates trans identity with a diagnosis of gender dysphoria and therefore fails to consider trans individuals without a diagnosis of gender dysphoria. Trans individuals may not have a gender dysphoria diagnosis due to difficulties accessing gender identity clinics, or because they do not feel clinically significant levels of distress which would require medical attention (Drescher & Pula, 2019). As such, here we examined the overlap between autism and trans identity, defined by the individuals themselves.

First, we sought to replicate previous evidence suggesting co-occurrence of autism and trans identity. Second, given mixed findings regarding whether the overlap between autism and trans identity is limited to trans men, we also sought to compare the overlap in trans men and trans women. The final aspect of this study looked at self-reported depression and anxiety. Reflecting

Table 1
Demographic information for each participant group.

	ASD				TD			
	Trans		Cis		Trans		Cis	
	TransM	TransW	Male	Female	TransM	TransW	Male	Female
N	19	6	11	26	57	42	101	465
Age	23.21 (6.49)	25.67 (8.12)	31.91 (12.37)	33.12 (11.01)	25.35 (7.08)	32.07 (14.70)	29.88 (13.07)	27.61 (10.98)
No. ESL	1	0	1	2	1	3	20	134
No. from UK	12	3	7	21	45	20	77	395
No. depression diagnosis	10	6	4	9	23	23	18	95
No. anxiety diagnosis	10	4	3	14	22	20	11	91
No. gender dysphoria	13	4	0	0	38	32	0	0

ESL = English second language; UK = United Kingdom.

previous evidence, we predicted that depression and anxiety rates would be higher in trans individuals than cis individuals, and in autistic compared to non-autistic individuals. However, given that a diagnosis of autism may prevent individuals who identify as trans to seek out and benefit from the social support that is important for their mental health outcomes, we expected that the highest levels of depression and anxiety would be observed in individuals who reported a diagnosis of autism and identified as trans. Specifically, we aimed to elucidate whether the impact of autism and trans identity on depression would be additive (as evidenced by main effects of both autism and trans identity) or superadditive (as evidenced by an interaction between autism and trans identity on anxiety and depression).

2. Method

2.1. Participants

Ethical approval was granted by the local ethics subcommittee. In line with the declaration of Helsinki, informed consent was obtained, and participants were fully debriefed upon completion. 961 participants were recruited via social media platforms, databases of individuals interested in taking part in psychological research and local student populations. To achieve an adequate sample of individuals who reported a diagnosis of autism and who identified as gender variant, advertisements were placed in order to reach these populations. The advertisement detailed that the project aimed to assess whether gender fluidity was associated with autistic traits. A prize draw was used to incentivise participation, with 66 psychology students also receiving course credits. Of the 961 individuals, 805 participants completed the survey. Three participants who reported their sex assigned at birth as 'other' were excluded resulting in 802 cases (M_{age} = 28.26, SD_{age} = 11.28, Age range = 18–74). In the final sample, 175 were sex assigned male and 627 were sex assigned female (for coding of gender identity please see Results). 634 participants reported English as their first language and 635 individuals were based in the United Kingdom. For demographic information see Table 1.

2.2. Method

Questionnaires were completed online via Qualtrics (Provo, UT). Participants provided demographic information, including their sex assigned at birth and their gender identity (Male, Female, Trans, Trans Man, Trans Woman, Gender Queer, Other) with participants permitted to select more than one option for their gender identity. In addition, participants completed several questionnaires including the Autism-Spectrum Quotient (AQ-50; Baron-Cohen et al., 2001) and the Depression, Anxiety and Stress Scale (DASS-21; Lovibond & Lovibond, 1995). The AQ-50 is an autism screening tool consisting of 50 questions assessing five different areas: social skills, attention switching, attention to detail, communication and imagination. The DASS-21 is a shortened version of the longer DASS questionnaire which provides separate subscales for depression, anxiety and stress. The reliability and validity of the AQ (e.g., Baron-Cohen et al., 2001; Hoekstra, Bartels, Cath, & Boomsma, 2008; Broadbent, Galic, & Stokes, 2013) and DASS-21 (e.g., Antony, Bieling, Cox, Enns, & Swinson, 1998; Henry & Crawford, 2005; Meier, Pardo, Labuski, & Babcock, 2013) have been well-established in a number of typical and clinical samples. Questionnaires were completed in a randomised order and took approximately 35 min to complete.

2.3. Operationalisation of gender identity

To operationalise gender identity several groups were formed. Individuals whose reported gender identity (male or female only) matched their sex assigned at birth were included in the cis group (N = 603; 112 cis males and 491 cis females). Individuals identifying as gender queer or other were excluded from the cis group. Individuals who identified their gender as either male or female and for whom this did not match their reported sex assigned at birth, or who identified as trans, trans man, or trans woman, were included in the trans group (N = 124). In the trans group, individuals who identified as gender queer or other were included if they had selected one of the trans categories also. Of the 124 individuals in the trans group, 58.06% also endorsed the label of male or

female, with 20.97% endorsing the label of gender queer and 20.97% identifying as 'other'. The trans group was subdivided into individuals identifying as a trans man (individuals who selected trans man or who reported their assigned sex as female but identified as male or trans; N = 76) or a trans woman (individuals who selected trans woman or who reported their assigned sex as male but identified as female or trans; N = 48). All individuals reporting a diagnosis of gender dysphoria (N = 87) self-identified as trans, with 29.84% of the sample who identified as trans not reporting a formal diagnosis of gender dysphoria.

After coding, the final sample comprised of 727 individuals (M_{age} = 28.13, SD_{age} = 11.33, Range 18–74), including 62 individuals who reported a diagnosis of autism (Table 1). No age differences were found between individuals identifying as transgender (M_{age} = 27.31, SD_{age} = 10.77) or cis (M_{age} = 28.30, SD_{age} = 11.44) ($t(725)$ = .885, p > .250). Likewise, no age differences were found between individuals reporting a diagnosis of autism (M_{age} = 29.15, SD_{age} = 10.62) and those who did not (M_{age} = 28.04, SD_{age} = 11.40) ($t(725)$ = -.734, p > .250). In the full sample, age was not correlated with AQ-50 scores, or depression, but showed a small negative association with anxiety (Spearman: $r(725)$ = -.203, p < .001). Whilst self-reported autism was sufficient for inclusion in the autism group, analysis of scores on the AQ-50 revealed clear overlap between those reporting a diagnosis and those that met cut-off on this measure (scores > 32; Baron-Cohen et al., 2001) ($X^2 (1)$ = 160.56, p < .001).

2.4. Analysis plan

For categorical analyses chi-square tests were utilised. For all comparisons using continuous dependent variables robust methods were utilised (Field & Wilcox, 2017; Wilcox, 2011) as the data were found to have substantial skew, the groups had unequal sample sizes, and often presented with unequal variances. Given previous literature in this area, we were interested in examining specific relationships (e.g., the difference between trans men and trans women, as well as differences between people with the same sex assigned at birth and individuals who share the same gender identity). We therefore followed up all ANOVA's with robust Yuen t-tests to allow us to examine these relationships. All reported p-values are two-tailed. For autistic traits, both analysis of continuous scores and analyses based on cut-off scores are reported. As the DASS-21 (DASS-21; Lovibond & Lovibond, 1995) does not provide cut-off scores, continuous scores are reported.

3. Results

3.1. Overlap between self-reported autism diagnosis and trans identity

The overlap between trans identity and autism was significant, $X^2 (1)$ = 25.94, p < .001. Within the sample not reporting a diagnosis of autism (N = 665), 566 individuals identified as cis (85.1%) and 99 individuals identified as trans (14.9%). Within the sample reporting a diagnosis of autism (N = 62), 37 identified as cis (59.7%) and 25 identified as trans (40.3%) (Fig. 1).

3.2. Autistic traits in trans populations

3.2.1. Cut-off scores

When AQ-50 cut off-scores were utilised (Baron-Cohen et al., 2001), a significant overlap was found between individuals who met cut-off and those identifying as trans, $X^2 (1)$ = 71.22, p < .001. In the cis group, 10.3% met cut off, in comparison to 40.3% in the trans group. This overlap remained when individuals reporting a diagnosis of autism were removed, $X^2 (1)$ = 56.35, p < .001, with 6.5% of the cis sample meeting cut-off in comparison to 31.3% of the trans sample.

The proportion of trans women who met cut-off (22.9%) did not significantly differ from cis men (11.6%), $X^2 (1)$ = 3.37, p = .066, but was slightly higher than cis women (10.0%), $X^2 (1)$ = 7.40, p = .007. The pattern of results was similar when individuals reporting a diagnosis of autism were removed; more trans women met cut off (14.3%) than cis women (6.2%), $X^2 (1)$ = 3.88, p = .049, but not cis men (7.9%), $X^2 (1)$ = 1.36, p > .20. In contrast, the proportion of trans men that met cut off
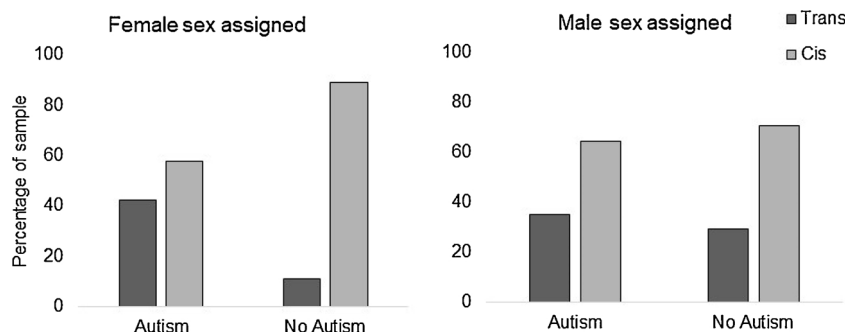

Fig. 1. The percentage of individuals in each participant group (with and without a diagnosis of autism, panelled by sex assigned at birth) who identified as transgender or cisgender. As can be seen, individuals with a diagnosis of autism were more likely to identify as transgender, with this effect greater in individuals who were sex assigned female at birth (i.e., trans men).

Table 2
Descriptive statistics for all key variables.

	Trans				Cis			
	TransW		TransM		Female		Male	
	M	SD	M	SD	M	SD	M	SD
AQ	22.90	10.26	31.29	10.88	19.43	9.01	20.88	8.68
AQ. Social Skill	4.77	2.64	6.09	2.83	3.30	2.82	3.75	2.85
AQ. Attention Switching	5.92	2.79	7.57	2.29	5.15	2.44	5.38	2.26
AQ. Communication	4.35	3.12	6.46	3.09	3.13	2.54	3.68	2.48
AQ. Imagination	3.10	2.15	5.03	2.65	2.52	2.00	2.79	1.89
AQ. Attention to detail	4.75	2.31	6.14	2.62	5.33	2.32	5.29	2.23
Depression	20.67	11.14	17.82	12.19	11.87	10.08	12.84	10.00
Anxiety	12.29	9.26	13.42	10.51	9.11	7.67	8.46	7.08

AQ = Autism Spectrum Quotient. Depression and Anxiety = subscales from the Depression and Anxiety Stress Scale.

(51.3%) was significantly higher than both cis men (11.6%), X^2 (1) = 35.68, p < .001, and cis women (10%), X^2 (1) = 85.77, p < .001. This pattern of results was similar when individuals reporting a diagnosis of autism were removed; more trans men met cut off (43.3%) than cis men (7.9%), X^2 (1) = 28.48, p < .001, and cis women (6.2%), X^2 (1) = 77.49, p < .001. When directly compared, trans men (51.3%) were more likely to meet cut off than trans women (22.9%), X^2 (1) = 9.860, p = .002. This result remained after the removal of individuals reporting a diagnosis of autism; more trans men met cut off (43.9%) than trans women (14.3%), X^2 (1) = 9.83, p = .002.

3.2.2. Continuous scores

Descriptive statistics are provided in Table 2. Continuous total scores on the AQ were analysed using a 2 (sex assigned at birth: male vs. female) x 2 (gender identity: cis vs. trans) between-subjects robust ANOVA. A main effect of sex assigned at birth was observed (F_t = 11.93, p < .001), whereby AQ scores were higher in individuals sex assigned male than sex assigned female. A significant main effect of gender identity was observed (F_t = 36.83, p < .001), whereby AQ scores were higher in trans individuals than cisgender individuals. Importantly, a significant interaction was observed between gender identity and sex assigned at birth, (F_t = 25.43, p < .001). Follow-up robust Yuen t-tests revealed that AQ scores were significantly higher in trans men compared to cis women (M_{diff} = -14.18 [-17.36, -11.01], Y_t = -9.228, p < .001, $\hat{\xi}$ = 0.72) and cis men (M_{diff} = 12.15 [-15.82, -8.49], Y_t = -6.82, p < .001, ξ = 0.67). In contrast, trans women showed similar AQ scores to cis men (M_{diff} = -1.31 [-5.41, 2.79], Y_t = -0.623, p > .250, ξ = 0.10) and cis women (M_{diff} = -3.34 [-7.24, 0.57], Y_t = -1.76, p = .095, ξ = 0.22). Finally, trans men showed significantly higher AQ scores than trans women (M_{diff} = -10.84 [6.08, 15.61], Y_t = -4.57, p < .001, $\hat{\xi}$ = 0.53). The removal of individuals reporting a diagnosis of autism did not change the overall pattern of significance.

To see whether the above results were driven by differences on a specific subscale of the AQ, the above analysis was conducted separately for each subscale of the AQ (for descriptive statistics see Table 2). Interactions between sex assigned at birth and gender identity were observed for all subscales of the AQ (all interactions p < .02). Follow up robust t-tests revealed that on all subscales of the AQ trans men scored significantly higher than cis men (all p < .001 except attention to detail, p < .025) and cis women (all p < .001 except attention to detail, p = .029). Removal of individuals with autism had little effect on the results, except differences on the attention to detail subscale for the comparison between trans men and cis men (p = .075) and trans men and cis women (p = .052) were no longer significant. In contrast, trans women scored higher than cis women only on the social skill and communication subscales of the AQ (both p < .05; all others p > .09), and only marginally higher than cis men on the social skill subscale of the AQ (p < .05; all others p > .250). Removal of individuals reporting a diagnosis of autism had little effect on the pattern of results, except that the difference between trans women and cis women on the communication subscale was no longer significant (p = .071) and no significant difference was observed between trans women and cis men (all p > .063). Finally, trans men scored significantly higher than trans women on all subscales of the AQ (all p < .01), a pattern of results that did not change after the removal of individuals reporting a diagnosis of autism (Fig. 2).

3.3. The impact of autism and trans identity on depression and anxiety

We then sought to examine the impact of autism and trans identity on depression and anxiety. Whilst our intention was to assess the impact of autism diagnosis, gender identity and sex assigned at birth on mental health outcomes, this was not possible as group numbers were too low (e.g., only 6 trans women reported a diagnosis of autism and only 19 trans men reported a diagnosis of autism; likewise when examining cut-off scores only 11 trans women met cut off on the AQ). Given that trans men and trans women did not differ in terms of depression and anxiety (both Yt < 1.5, p > .12) these groups were combined. We therefore examined the impact of autism and trans identity on depression and anxiety using a 2 (Autism: Diagnosis vs. No diagnosis) x 2 (Gender identity: Trans vs. Cis) robust ANOVA for depression and anxiety separately.

For depression scores, a main effect of autism was observed (F_t = 11.95, p = .002) whereby depression scores were higher in individuals reporting a diagnosis of autism. A main effect of gender identity was also observed (F_t = 15.36, p = .001), whereby individuals identifying as trans had higher rates of depression than those who identified as cis. No interaction between gender
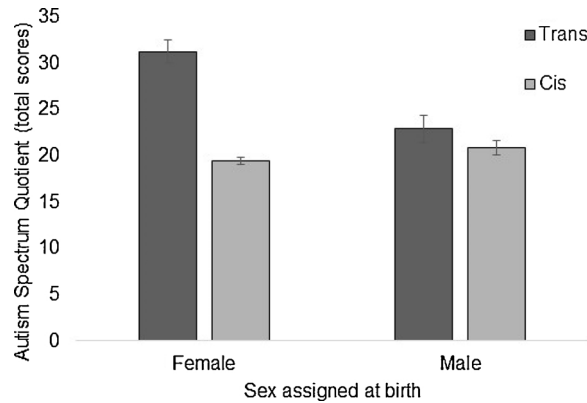
Fig. 2. Scores on the autism-spectrum quotient (AQ) for transgender and cisgender individuals. As can be seen, AQ scores were highest in transgender men (left; individuals sex assigned female who identify as male) than all other groups. Transgender women (individuals sex assigned male who identity as female) had marginally higher scores than cisgender men and women, though this did not reach threshold significant (see text). This graph includes individuals with a self-reported diagnosis of autism, however, it is notable that a similar pattern of results was observed when these individuals were removed (see text). AQ scores range from 0-50. Error bars indicate +/- 1 SE.

identity and autism diagnosis on depression scores was observed ($F_t = 0.49$, $p > .250$), indicating no superadditive effect of gender identity and autism diagnosis on depression (Table 3).

For anxiety scores, a similar pattern of results was found. There was a main effect of autism ($F_t = 14.50$, $p = .001$), whereby anxiety scores were higher in individuals who reported a diagnosis of autism. Likewise, there was a main effect of gender identity ($F_t = 5.94$, $p = .019$), whereby trans individuals reported higher rates of anxiety than cis individuals. No interaction between gender identity and autism diagnosis on anxiety scores was observed ($F_t = 0.55$, $p > .250$), indicating no superadditive effect of gender identity and autism diagnosis on anxiety (Table 3, Fig. 3).

4. Discussion

The present study examined the overlap between gender identity and autism and the impact of any observed overlap on mental health. Consistent with previous findings a significant overlap between an autism diagnosis and trans identity was observed. Higher rates of autistic traits were found in trans individuals, even when those reporting an autism diagnosis were excluded. Autistic traits were higher in trans men than cis women or trans women, whether or not those reporting an autism diagnosis were included. In contrast, trans women only scored marginally higher than cis men and cis women on certain subscales of the AQ. As predicted, depression and anxiety levels were significantly higher in trans than cis individuals and those with an autism diagnosis, compared to those without. Whilst the highest levels of depression and anxiety were observed in those who were both trans and autistic, no superadditive effect was observed (i.e. as no interaction between gender identity and autism was observed, the combination of being trans and autistic had no more effect on levels of depression and anxiety than would be expected based on the additive effect of each factor alone).

4.1. Overlap between trans identity and autism

Consistent with previous studies we found significant overlap between autism and trans identity. Compared to cisgender individuals, autistic traits were higher in those identifying as trans (e.g., Pasterski et al., 2014). These findings provide further support for this overlap not just being present in children and adolescents, but also extending into adulthood (Jones et al., 2012; Pasterski et al., 2014; Kristensen & Broome, 2016; Dewinter et al., 2017; Walsh et al., 2018). Building on studies focusing on rates of autism in those referred to gender identity clinics, these data provide evidence that individuals who self-identify as transgender display more autistic traits than cisgender individuals. Importantly, the finding that autistic traits are higher in trans individuals who do not report

Table 3
Depression and anxiety scores as a function of gender identity and autism diagnosis.

| | ASD | | | | TD | | | |
| | Trans | | Cis | | Trans | | Cis | |
	M	SD	M	SD	M	SD	M	SD
Depression	24.32	11.91	16.43	11.34	17.56	11.47	11.77	9.92
Anxiety	18.72	10.89	13.08	9.09	11.54	9.30	8.72	7.38

Depression and Anxiety = subscales from the Depression and Anxiety Stress Scale.
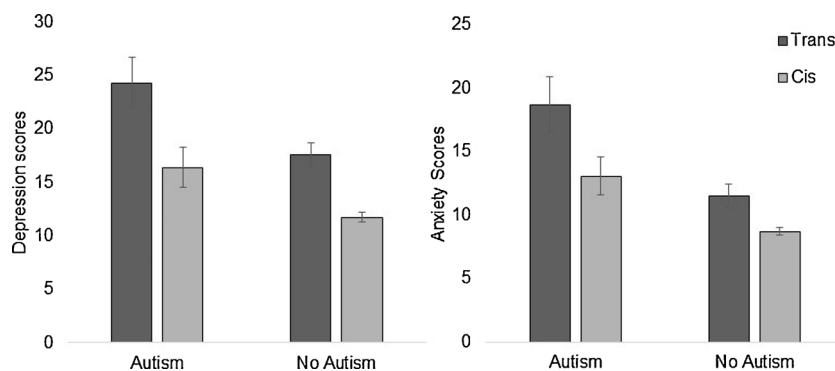
Fig. 3. Depression and anxiety scores (from the Depression, Anxiety and Stress Scale (DASS-21)) for transgender and cisgender individuals who did and did not report a diagnosis of autism. As can be seen, depression and anxiety rates were higher in individuals with autism than individuals who did not have a diagnosis of autism. Likewise, depression and anxiety rates were higher in individuals who identified as transgender than individuals who were cisgender. The highest rates of depression and anxiety were observed in individuals who identified as transgender and reported a formal diagnosis of autism. Scores on these subscales range from 0-42. Error bars indicate +/- 1 SE.

a diagnosis of autism suggests that trans individuals without a diagnosis of autism, either because they have not been able to access one, or because they don't fulfil the diagnostic criteria, also display more autistic traits than cis individuals.

These findings are consistent with reports that trans individuals may find it more difficult to access services, which may include services which facilitate autism diagnosis (NHS England, 2015). Conversely, the fact that a quarter of individuals identifying as trans did not report a formal diagnosis of gender dysphoria, also speaks to the possibility that an autism diagnosis may prevent trans individuals from accessing mental health support relating to their transition. Alternatively, this finding may suggest that some trans individuals don't meet the criteria for gender dysphoria, which provides further support for studies utilising self-identified trans identity rather than relying on a diagnosis, or measure, of gender dysphoria.

4.2. Autistic traits in Trans men vs. Trans women

In line with Jones et al. (2012), in this sample autistic traits were higher in trans men than trans women. Whilst this may reflect the true state of affairs it is important to note that this result is inconsistent with other studies reporting no difference between trans men and trans women (Pasterski et al., 2014; Skagerberg et al., 2015; Strang et al., 2014). One possibility is that this difference may reflect the usage of measures of autistic traits that are biased towards the male phenotype of autism. The AQ-50, which was used in this study as well as Jones et al. (2012), has been shown to be susceptible to gender bias (Ruzich et al., 2015). This raises the possibility that the AQ-50 may lack sensitivity to autistic traits in trans women. Such an assertion is consistent with evidence from cisgender individuals; there is growing appreciation that the autism phenotype may differ in males and females (Van Wijngaarden-Cremers et al., 2014), raising the possibility that autism in females may be missed when measures are biased towards males. Autistic women may also use more coping strategies, such as camouflaging, than autistic men, which could result in their autism going undetected for longer (e.g., Attwood et al., 2006). Indeed, in the present study, trans women only had marginally higher AQ scores than cis women and cis men, raising the possibility that comparable rates of autistic traits may be observed in trans men and trans women if more sensitive measures are utilised. It is possible therefore that measurement bias contributes both towards unrecognised autism and autistic traits both in cisgender and trans women.

4.3. Depression and Anxiety in autistic-trans individuals

Findings concerning depression and anxiety in autistic-trans individuals showed that those who identified as trans and autistic had greater depression and anxiety symptoms than those who were trans but not autistic, or cis and autistic. These findings are consistent with previous evidence suggesting increased emotional problems in autistic adults and adolescents who endorsed gender variance (van der Miesen, de Vries et al., 2018). The use of a control group in the present study, however, revealed no superadditive effect of being trans and autistic on depression and anxiety, consistent with previous evidence examining the impact of gender dysphoria and autism on mental health (George & Stokes, 2018). This suggests that although trans identity and autism both contribute to increased depression and anxiety in autistic-trans individuals, the two do not interact to create an additional increase in depression and anxiety. Regardless, these data suggest an increased mental health burden for individuals who identify as transgender and autistic and highlight the importance of achieving better access to mental health services for autistic-trans individuals than the current system may allow (Whittle, Turner, & Al-Alami, 2008).

It is notable that the results of the present study and those of George and Stokes (2018) are not consistent with Strang et al. (2014) finding that being transgender does not confer additional risk of depression and anxiety in autistic children and adolescents. Although Strang et al. (2014) observed that gender variance increased emotional symptoms in children with neurodevelopmental disorders, when looking at children with autism specifically, autistic children who exhibited gender variance did not have more emotional

symptoms than autistic children who did not exhibit gender variance. One possible reason for the discrepancy is that the children in the study by Strang et al. (2014) were engaged with mental health services, but it is also possible that the overlap between autism and trans identity confers greater risk of poor mental health at certain developmental stages. In adults, it is possible that depression and anxiety levels may fluctuate depending on the stage of gender transition. As rates of depression and anxiety reduce towards the later stages of transition (Budge, Adelson, & Howard, 2013), it may be that the additive effect of autism and trans identity on mental health differs depending on the transition stage. Consistent with this proposal, Olson, Durwood, DeMeules, and Mclaughlin (2016)) observed that socially transitioning (where a person makes those around them aware of their trans identity) protected the mental health of trans children, raising the possibility that prolonged transition may confer a greater risk of depression and anxiety. Taking this evidence into account, it may be that trans identity and autism do have a superadditive effect on depression and anxiety during the early or pre-transition stages. If a superadditive effect is present only in a small proportion of the sample (e.g., those at the early pre-transition stages) it would not be detected by the methods employed here. In contrast, in individuals that do not wish to transition, it may be that the impact of the autism/trans overlap does not confer greater risk of depression and anxiety. Future research, therefore, will benefit from a more nuanced approach to understanding the impact of gender identity and autism on mental health.

4.4. Limitations and future directions

Despite the importance of these findings it is important to acknowledge limitations. In addition to the use of the AQ-50, which may have artificially increased the prevalence of autistic traits in trans men, it should be noted that these data cannot be used to estimate the co-occurrence of trans identity and autistic traits in the general population, since we sought to recruit people who were gender variant. It is therefore evident that, since the study did not seek to obtain a representative sample of autistic, non-autistic, transgender, or cisgender populations, the evidence for any increase in the proportion of the autistic in comparison to the non-autistic population identifying as transgender should be viewed as preliminary. This caveat is reinforced by the fact this opportunity sample was characterised by differences in the number of participants assigned to the female and male sex at birth, and who reported cis vs trans gender identity. Furthermore, it must also be noted that although measures of autistic traits are routinely used in transgender populations, the validity of the AQ-50, and indeed other measures of autistic traits, within this population have yet to be established. It is therefore possible that these measures may over- or underestimate the prevalence of autistic traits in transgender populations.

This study may have also suffered from limitations inherent in carrying out research with the trans population. Trans individuals are difficult to reach population for several reasons. People who might be considered trans by society may not define themselves as trans or identify with the trans community. Often those who have completed physical transition, particularly trans men, no longer consider themselves trans (e.g., Factor & Rothblum, 2008). This has implications for mental health, as feeling part of the trans community plays an important role in psychological wellbeing of trans individuals (Barr, Budge, & Adelson, 2016). As it is unlikely that this survey will have reached individuals not actively involved in the trans community, we may have underestimated depression and anxiety levels in trans individuals. If future research is to understand the impact of transitioning on mental health, it will be important to engage these individuals in research.

By focusing on transgender individuals, this study did not investigate the overlap between autism and the wider trans community, specifically those who identify as non-binary, genderqueer or genderfluid. This may be particularly important given recent findings that autistic individuals may more readily identify as non-binary than transgender (Walsh et al., 2018). In the future, researchers should look at a wider trans population. Although this method poses several challenges; individuals often identify with several gender labels making stratification difficult. However, this approach will provide a greater understanding of the impact of gender variance on mental health.

Finally, because few trans women reported a diagnosis of autism or met cut off on the AQ it was not possible to investigate whether the impact of trans identity and autism on depression and anxiety differed as a function of sex assigned at birth. Although in this sample depression and anxiety did not differ between trans men and trans women, it is of course possible that the interaction between autism and gender identity on mental health outcomes differs for trans men and trans women. Future research in larger samples is required to address this outstanding question.

4.5. Conclusion

In conclusion, substantial overlap between trans identity and autism was observed, with certain autistic traits elevated in both trans men and trans women. Although no superadditive effect of trans identity and autism on depression and anxiety rates was observed, depression and anxiety were highest in autistic-trans individuals which were markedly higher than in the non-autistic cisgender population. It is therefore important that future research focus on further exploring the mental health outcomes of autistic-trans individuals.

Author contributions

JM and FP contributed equally to the manuscript.

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