Autistic traits and borderline personality disorder traits are positively correlated in UK and US adult men and women

Gareth Richards [a,*], Sally Kelly [a], Darren Johnson [a], John Galvin [b]

[a] School of Psychology, Faculty of Medical Sciences, Newcastle University, Newcastle upon Tyne, UK
[b] Department of Psychology, University of Warwick, UK

A R T I C L E   I N F O

A B S T R A C T

Co-occurrence of autism and borderline personality disorder (BPD) has been reported and may be more prevalent in women than men. However, the association between these conditions remains poorly understood, as does that between traits found throughout the general population. We present two studies which measured self-reported autistic traits (Autism Spectrum Quotient [AQ]) and BPD traits (McLean Screening Instrument for Borderline Personality Disorder [MSI-BPD]) in UK ($N = 695$) and US ($N = 700$) adults. As predicted, autistic and BPD traits correlated positively in both samples. However, there were no significant sex differences in the correlation strength. In the UK sample, the association between autistic traits (AQ total score) and BPD traits was no longer significant once current anxiety and depression symptoms (Hospital Anxiety and Depression Scale [HADS]) were controlled for. However, AQ subscales for Details/Patterns and Communication/Mindreading (but not Social Skills) remained significantly associated with MSI-BPD scores in the US sample. Our findings suggest that an overrepresentation of autistic women in patient populations with BPD may not be explained by traits of these conditions co-occurring to a greater degree in women than men. They also suggest that although both conditions are associated with elevated levels of anxiety and depression, BPD traits remain independently associated with specific domains of autistic traits.

1. Introduction

The current paper will investigate the correlation between autistic traits and borderline personality disorder (BPD) traits in general population samples from the UK and US. Autism is conceptualised as a spectrum characterised by social communication difficulties and repetitive and unusual sensory-motor behaviours (American Psychiatric Association, 2013; Lord et al., 2018), and is more commonly diagnosed in males than females (Zablotsky et al., 2015). BPD is a personality disorder that involves a pervasive pattern of instability that affects regulation, impulse control, interpersonal relationships, and self-image (American Psychiatric Association, 2013; Lieb et al., 2004), and is more commonly diagnosed in females than males (Skodol & Bender, 2003).

On the surface, there is overlap between some features of autism and BPD. For instance, social and emotion regulation difficulties characterise both, and those diagnosed often experience challenges maintaining personal relationships (May et al., 2021). However, the reasons for these shared difficulties are not easily identified. For instance, maintaining

relationships may be challenging for autistic individuals due to social avoidance, difficulties reading social cues, or social withdrawal (Bellini, 2004; Bellini & Hopf, 2007), whereas for individuals with BPD, maintaining relationships may be challenging due to mistrust, antagonising behaviours, frequently shifting emotions, or fear of abandonment (Minzenberg et al., 2006; Palihawadana et al., 2019). As autism is not routinely considered during a BPD evaluation, this could result in autistic symptoms being overlooked (or indeed BPD symptoms being overlooked during an autism assessment).

There is some evidence of sexual differentiation in the pattern of correlations observed between autistic traits and aspects of other clinical conditions. For instance, it has been found in two studies that the positive correlation between autistic traits and disordered eating is stronger in females than males (Barnett et al., 2021; Galvin et al., 2022). Regarding BPD, Rydén et al. (2008) noted undetected autism in a subgroup of women with BPD and reported that these women were at elevated risk of severe mental health difficulties. Considering that autism presents differently in women and men (Kirkovski et al., 2013),

that women are more likely to mask their autism than men (Hull et al., 2020), and that co-occurring mental health problems are more common in both autistic women (Sedgewick et al., 2021) and women with BPD (Johnson et al., 2003), it seems plausible that there may be sex-specific risks for misdiagnosis. Hofvander et al. (2009) observed a higher proportion of autistic females (15 %) than autistic males (5 %) with BPD, although it should be noted that the difference was not statistically significant ($p = .09$). Rydén and Bejerot (2008) reported significantly higher BPD traits in autistic females than autistic males within a psychiatric population. May et al. (2021) noted that clinician bias toward diagnosing women with BPD may extend to those with additional diagnoses and encouraged further research relating to traits as well as diagnoses for these conditions. In line with autism and BPD diagnoses, autistic traits are typically higher in men compared to women (Ruzich et al., 2015), and BPD traits are typically higher in women compared to men (Martin et al., 2023).

To our knowledge, only one study (Chabrol & Raynal, 2018) has reported on the relationship between autistic and BPD traits in a non-clinical sample, and it found a positive correlation. Although the study did not observe sex ratio differences in the groups clustered by high/low autistic and BPD traits, this could reflect methodological limitations. First, the short-form Autism Spectrum Quotient (AQ-10; Allison et al., 2012) was used; this is intended as a clinical screening tool and has different properties to the original 50-item AQ (Baron-Cohen et al., 2001), which is more appropriate for research examining autistic traits in non-clinical populations. Second, autistic and BPD traits were dichotomised into high and low scores, reducing statistical power, and increasing the likelihood of making Type 2 errors.

The current paper reports on two studies, one utilising a UK sample (Study 1), the other a US sample (Study 2), that examined autistic and BPD traits within adult general populations. The aim of Study 1 was to establish whether there is a stronger correlation in women than men. As anxiety and depression are frequently associated with autism (Hollocks et al., 2019) and BPD (Tomko et al., 2014), we also tested whether the correlation is independent of current symptom of anxiety and depression. We pre-registered our hypotheses/analysis plan on the Open Science Framework (https://osf.io/g56zu), and, based on the previously discussed literature, predicted that (1) there would be sex differences for autistic traits (men > women), BPD traits (women > men), and symptoms of anxiety (women > men) and depression (women > men); (2) autistic and BPD traits would correlate positively in women and men; (3) the correlation between autistic and BPD traits would be stronger in women than men; and (4) the association between autistic and BPD traits would be independent of current symptoms of anxiety and depression.

2. Study 1 method

2.1. Participants

An online Qualtrics survey was advertised on the Prolific (www.prolific.co) research recruitment platform. Inclusion criteria were that participants be 18 years or older and their sex was male or female. Ethical approval was granted by the Faculty of Medical Sciences Research Ethics Committee, Newcastle University (approval number: 16567/2021), and the research was performed per the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Participants provided informed consent to take part in this research and for the resulting anonymised data to be made publicly available. Statistical analyses were conducted in RStudio version 4.3.0 (R Core Team, 2023), and graphics were created using the ggplot2 package (Wickham, 2009).

A priori power calculations (G*Power 3.1; Faul et al., 2009, 2007) determined the required sample size. Based on the correlation between autistic and BPD traits reported by Chabrol and Raynal (2018) ($r = 0.20$), $N = 193$ participants would be required to observe a significant

effect with a two-tailed Pearson's test with 80 % power and α set at $p < .05$. As we intended to examine correlations in men and women separately, and because we predicted the strength of correlation would be moderated by sex, we conducted separate power calculations. Assuming effect sizes of $r = 0.15$ (men) and $r = 0.30$ (women), $n = 346$ and $n = 84$ would be required, respectively. However, a larger sample would be required to reliably determine whether correlation strength differs significantly via Fisher's r-to-z test. We, therefore, aimed to collect data from $n = 350$ men and $n = 350$ women. Assuming effect sizes of $r = 0.15$ and $r = 0.30$, a comparison of slopes with samples this size would be statistically significant ($p = .037$, two-tailed).

2.2. Materials

The McLean Screening Instrument for Borderline Personality Disorder (MSI-BPD) (Zanarini et al., 2003) was used to measure traits characteristic of BPD. This self-report screening tool includes 10 items answered with 'Yes' or 'No'. These are based on a subset of questions from the Diagnostic Interview for DSM-IV Personality Disorders. Unfortunately, due to a technical error, the last item, "Have you made desperate efforts to avoid feeling abandoned or being abandoned (e.g., repeatedly called someone to reassure yourself that he or she still cared, begged them not to leave you, clung to them physically)?", was not administered. We, therefore, calculated the sum of the nine available items. Internal consistency (Cronbach's alpha) was satisfactory (i.e., > 0.70; Bland & Altman, 1997), α = 0.804.

The Autism Spectrum Quotient (AQ; Baron-Cohen et al., 2001) was used to measure autistic traits. Items for this 50-item self-report questionnaire are answered on a 4-point Likert scale, and a maximum score of 50 was generated by coding 'definitely agree' and 'slightly agree' as 1, and 'slightly disagree' and 'definitely disagree' as 0 (please note that 26 items are reverse-scored). These are structured around five subdomains: Social Skill, Attention Switching, Attention to Detail, Communication, and Imagination (Baron-Cohen et al., 2001). Internal consistency for the total score was satisfactory, α = 0.844.

The Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) was used to index participants' mental health during the previous week. Participants are instructed to answer the scale in a manner that most closely reflects how they have been feeling in the past week and to not take too long for their reply as their immediate answer is best. This self-report screening measure is answered using a 4-point Likert scale (response options vary across questions). Separate scores were calculated for anxiety (7-items) and depression (7-items) (0–7 = normal; 8–10 = borderline abnormal; 11–21 = abnormal). Six items were reversed scored. Internal consistency was satisfactory: anxiety, α = 0.850; depression: α = 0.813.

2.3. Design and procedure

A correlational design was used. Participants were administered an information sheet and asked to provide consent. They then reported their age, sex, and ethnicity before completing the BPD, autism, and anxiety and depression traits measures. After this, they reported whether they had a diagnosis (or suspected such a diagnosis could apply to them) for anxiety, autism, BPD, and depression. Data were collected in January 2022; participants were paid £0.88 for taking part and provided with a debrief form on completion. We specified that we would include three attentional check questions within the survey and that data would be retained if at least two were answered correctly. However, these were not presented due to the same technical error mentioned above. We, therefore, retained data for all participants who completed the survey.

3. Study 1 results

3.1. Descriptive statistics

760 people accessed the survey; $n = 703$ completed the AQ, $n = 719$ completed the MSI-BPD, and $n = 703$ completed both measures. Of these latter participants, $n = 347$ (49.4 %) were female, $n = 348$ (49.5 %) were male, $n = 5$ (0.7 %) preferred not to say, and $n = 3$ (0.4 %) self-described. As a primary aim of the current study was to test for sex differences in the correlation between AQ and MSI-BPD scores, we restricted further analysis to those participants who reported their sex to be male or female ($n = 695$). Ethnicity for this group was distributed as follows: White ($n = 594$, 85.7 %); Mixed or Multiple ethnicity ($n = 22$, 3.2 %); Asian ($n = 54$, 7.8 %); Black ($n = 16$, 2.3 %); other ethnicity ($n = 7$, 1.0 %) (there were $n = 2$ missing values). The age range was 18–88 years ($n = 695$, $M = 38.14$, $SD = 13.13$). The frequencies of reported conditions were as follow: autism: $n = 16$ (2.3 %) diagnosed, $n = 124$ (17.9 %) suspected; BPD: $n = 11$ (1.6 %) diagnosed, $n = 42$ (6.1 %) suspected; anxiety: $n = 175$ (25.3 %) diagnosed, $n = 231$ (33.3 %) suspected; depression: $n = 194$ (28.0 %) diagnosed, $n = 139$ (20.1 %) suspected (there were $n = 2$ missing values in each case).

3.2. Sex differences and correlational analysis

Men scored on average higher than women for autistic traits, and women scored on average higher than men for BPD traits and anxiety; there was no difference for depression (Table 1). Autistic and BPD traits correlated positively in women, r (345) = 0.336, $p < .001$, and men, r (346) = 0.268, $p < .001$ (Fig. 1). There was no significant difference in the strength of correlation, $z = 0.98$, $p = .326$, Cohen's $q = 0.075$.

3.3. Multiple linear regression analysis

We conducted multiple linear regression ($n = 693$) to determine whether the association between autistic and BPD traits remained significant once age, sex, and current symptoms of anxiety and depression were controlled for statistically. Although we intended to include the AQ × sex interaction term (calculated based on centred total AQ scores), strong correlation between this and AQ score caused multicollinearity problems (for AQ, variance inflation factor [VIF] = 10.31, and tolerance = 0.10; for AQ × Sex, VIF = 10.06, and tolerance = 0.10). Omitting the interaction term from the model resulted in acceptable VIF (all < 2) and tolerance (all > 0.50). The model fit the data well, F (5, 687) = 76.01, $p < .001$, and predicted ~35 % of variance in MSI-BPD scores (adjusted $R^2 = 0.35$). However, although the assumption that error is independent between predictors was met (Durbin-Watson = 1.918, $p = .294$), there was significant heteroscedasticity ($p = .033$) and non-normality of residuals ($p < .001$). We, therefore, recomputed the model using bootstrapping (10,000 resamples), as this process does not assume normality of distribution for the error term. The resulting model showed that AQ and sex were no longer significant predictors; age (lower), anxiety (higher), and depression (higher) were independent predictors of higher MSI-BPD scores (Table 2). Although not pre-registered, we also conducted bootstrapped (10,000 resamples) linear regression analyses, stratified by sex (women, $n = 346$; men, $n = 347$), with age, HADS

anxiety, and HADS depression as covariates (Table 2). In each case, age (lower), anxiety (higher), and depression (higher) were significant predictors of higher MSI-BPD scores. Examination of the bias corrected and accellerated 95% confidence intervals (BCa 95% CIs) suggested AQ score was positively associated with MSI-BPD score in women, although the effect was not statistically significant (BCa 95 % CI: −0.002–0.065); there was no such effect in men (BCa 95 % CI: −0.025–0.039).

4. Study 1 discussion

As predicted, autistic traits (AQ total score) and BPD traits (MSI-BPD score) correlated positively in men and women. Contrary to our predictions, however, sex did not moderate the strength of correlation, and AQ was no longer a significant predictor of BPD traits once current symptoms of anxiety and depression were controlled for statistically. Although, a sex-stratified analysis suggested the association might be independent of current mental health status in women, the effect was not quite statistically significant.

Strengths of Study 1 include its pre-registered hypotheses/analysis plan and large sample size informed by a priori power calculations. However, a considerable limitation occurred in that one of the 10 items from the MSI-BPD was not administered due to a technical error. Therefore, although the study provides evidence of a positive correlation between autistic and BPD traits within the UK general adult population, its findings may not be directly comparable to those of studies using the full 10-item MSI-BPD. The generalisability of the findings is also limited, as a significant level of heteroscedasticity was detected.

Considering the above limitations, we conducted a replication study using the US participant pool available through Prolific and pre-registered it on the OSF (https://osf.io/u2dmk). Instead of examining only AQ total scores, as in Study 1, we additionally examined AQ sub-scale scores calculated based on the factor structure observed by Russell-Smith et al. (2011, Study 1). This structure comprises three factors – Social Skills, Details/Patterns, and Communication/Mindreading – and has been found to be the most empirically supported of the many different factor structures derived from this measure in the literature (English et al., 2020). We predicted (1) there would be sex differences for autistic traits (AQ total score, AQ Social Skills, AQ Details/Patterns, and AQ Communication/Mindreading) (men > women), BPD traits (women > men), and symptoms of anxiety (women > men) and depression (women > men); (2) autistic and BPD traits would correlate positively in women and men; and (3) the correlation between autistic and BPD traits would be stronger in women than men. Whereas for Study 1, in which we had predicted that the association between autistic and BPD traits would remain significant after current symptoms of anxiety and depression had been controlled for statistically, we did not make such directional predictions again here. Instead, we conducted an exploratory analysis to determine whether any of the three aforementioned AQ subscale scores remained significantly associated with BPD traits when simultaneously entered as predictor variables alongside covariates that included current symptoms of anxiety and depression.

Table 1
Descriptive statistics and sex differences (Study 1).

	Overall sample			Women			Men			Comparison			
	n	M	SD	n	M	SD	n	M	SD	t	df	d	p
AQ	695	21.25	8.02	347	20.28	8.04	348	22.23	7.89	−3.227	692.68	−0.245	0.001
MSI-BPD	695	3.52	2.68	347	3.85	2.70	348	3.19	2.61	3.245	692.09	0.246	0.001
HADS anxiety	693	8.16	4.49	346	8.90	4.36	347	7.42	4.50	4.380	690.46	0.333	<0.001
HADS depression	693	6.04	3.95	346	5.92	3.80	347	6.17	4.10	−0.816	687.50	−0.062	0.415

Note. AQ, Autism Spectrum Quotient; HADS, Hospital Anxiety and Depression Scale; MSI-BPD, McLean Screening Instrument for Borderline Personality Disorder.
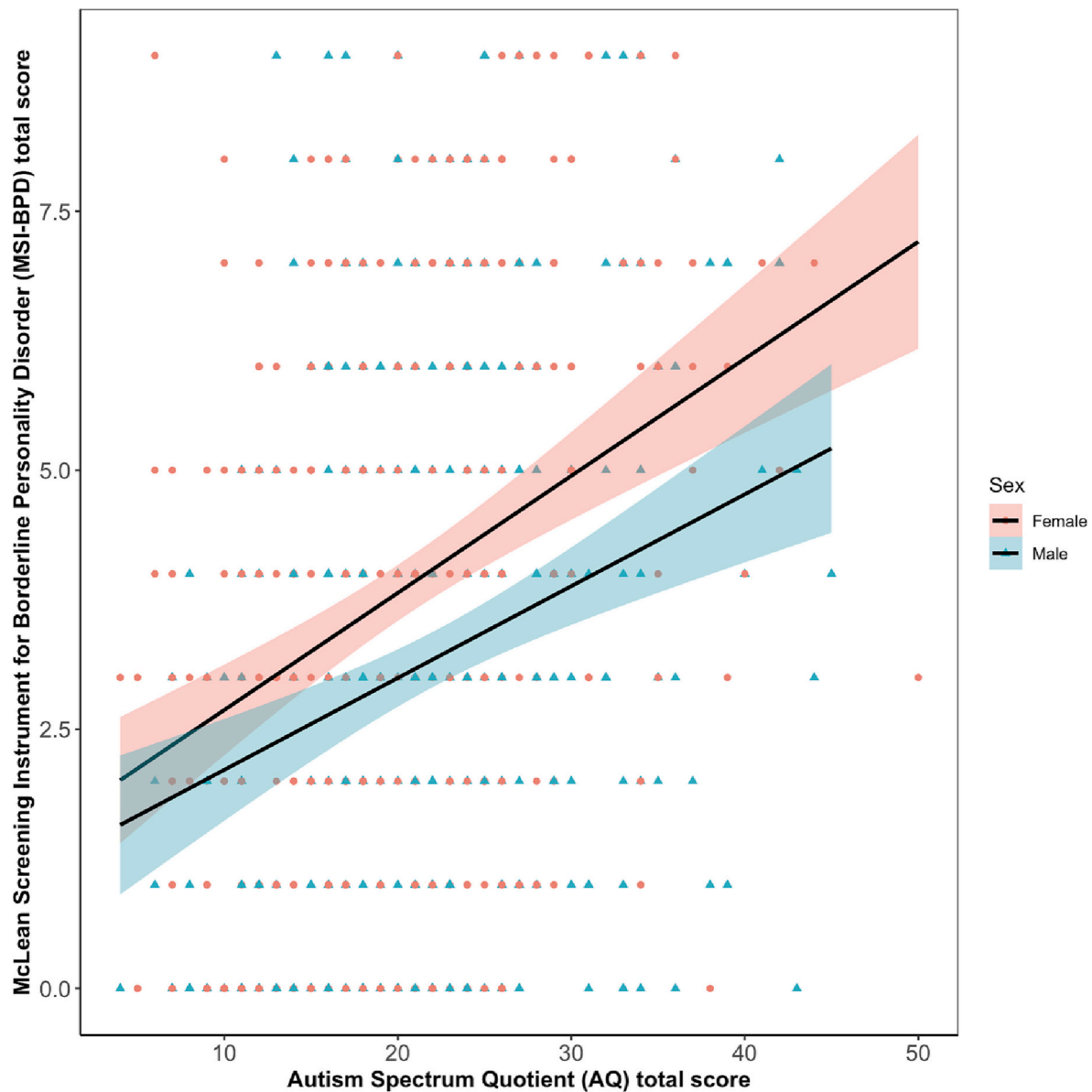
Fig. 1. Scatterplot showing the correlation between autistic traits (AQ total score) and BPD traits (MSI-BPD score) stratified by sex (Study 1).

5. Study 2 method

5.1. Participants

As with Study 1, we utilised a Qualtrics survey, with inclusion criteria being that participants were 18 years or older and reported their sex to be either male or female. We again aimed to recruit a sample of $n = 350$ men and $n = 350$ women, based on the a priori power analysis conducted for Study 1, though this time utilised the US (rather than UK) participant pool on Prolific. This was to ensure that different respondents took part from those included in Study 1 and to provide a cross-national replication. We also requested from Prolific a sample that was representative of US census data in terms of age, sex, and ethnicity. Ethical approval was covered via an amendment made to the agreement in place for Study 1 (approval number: 16567/2021). Participants provided informed consent to take part in the study and for the resulting anonymised data to be made publicly available.

5.2. Materials

We employed the same measures as in Study 1. To address the earlier technical error, we ensured that all items from each measure were presented to participants and that three attention check questions were included (one each appearing within the MSI-BPD, AQ, and HADS). To calculate AQ subscale scores, we summed those items reported to load on each factor as in Appendix A of Russell-Smith et al. (2011): Social Skills (items 1, 10, 11, 13, 15, 17, 22, 26, 34, 38, 44, 46, and 47); Details/Patterns (items 5, 6, 9, 12, 19, 23, and 41); Communication/Mindreading (items 20, 27, 31, 35, 36, 39, 45, and 48). Internal consistency was satisfactory for the AQ total score, $\alpha = 0.821$, and for Social Skills, $\alpha = 0.862$, and Details/Patterns, $\alpha = 0.733$, but unsatisfactory for Communication/Mindreading, $\alpha = 0.638$. Internal consistency was satisfactory for each of the other measures: MSI-BPD, $\alpha = 0.840$; HADS anxiety, $\alpha = 0.878$; HADS depression, $\alpha = 0.855$.

5.3. Design and procedure

Study 2 followed the same design and procedure as Study 1. The only

Table 2
Bootstrapped (10,000 resamples) multiple linear regression models with autistic traits (AQ total score) as predictor and BPD traits (MSI-BPD score) as outcome (Study 1).

		β	BCa 95 % CI
Whole sample	Intercept	2.001	1.209–2.840
	AQ total	0.018	−0.004–0.042
	Sex	−0.319	−0.660–0.021
	Age	−0.027	−0.039 to −0.015
	HADS anxiety	0.211	0.163–0.259
	HADS depression	0.156	0.098–0.211
Women	Intercept	1.742	0.742–2.775
	AQ total	0.030	−0.002–0.065
	Age	−0.034	−0.054 to −0.013
	HADS anxiety	0.200	0.133–0.269
	HADS depression	0.160	0.072–0.242
Men	Intercept	1.421	0.470–2.401
	AQ total	0.006	−0.025–0.039
	Age	−0.023	−0.038 to −0.008
	HADS anxiety	0.217	0.148–0.286
	HADS depression	0.154	0.076–0.228

Note. The following covariates were included: age, HADS anxiety and HADS depression (all models), and sex (whole sample model only). AQ, Autism Spectrum Quotient; HADS, Hospital Anxiety and Depression Scale; BCa 95 % CI, bias corrected and accelerated 95 % confidence intervals; β, standardized beta coefficient.

differences of note were that data for Study 2 were collected in May 2023, participants were paid £1.28 for taking part, and that we recruited additional participants to replace those who answered more than one of the three attention check questions incorrectly and/or did not specify their sex as male or female ($n = 12$).

6. Study 2 results

6.1. Descriptive statistics

Seven hundred and fourteen people accessed the survey; all of these completed the MSI-BPD, and $n = 710$ completed the AQ. Two were removed from subsequent analyses due to answering two or more of the three attention check questions incorrectly, and eight others were removed because they could not be categorised as either male or female ($n = 5$ prefer not to say; $n = 3$ self-describe). Of the $n = 700$ participants retained for further analysis, $n = 355$ (50.7 %) were female, and $n = 345$ (49.3 %) were male. Ethnicity was as follows: White ($n = 516$, 74.0 %); Mixed or Multiple ethnicity ($n = 39$, 5.6 %); Asian ($n = 39$, 5.6 %); Black ($n = 91$, 13.1 %); other ethnicity ($n = 12$, 1.7 %) (there were $n = 3$ missing values). Age ranged from 18 to 94 years ($M = 46.18$, $SD = 16.30$ [with one missing value]). Frequency of reported conditions was as follows: autism: $n = 18$ (2.6 %) diagnosed, $n = 107$ (15.3 %) suspected; BPD: $n = 12$ (1.7 %) diagnosed, $n = 51$ (7.3 %) suspected; anxiety: $n = 234$ (33.4 %) diagnosed, $n = 163$ (23.3 %) suspected; depression: $n = 209$ (29.9 %) diagnosed, $n = 135$ (19.3 %) suspected.

Due to the technical error encountered in Study 1 by which item 10 of the MSI-BPD was not administered to participants, we correlated the full (i.e., 10-item) total score with that calculated from the first nine items. The correlation was very strongly positive, $r(698) = 0.993$, $p < .001$, providing confidence that the results from Study 1 are unlikely to have been unduly affected.

6.2. Sex differences and correlational analysis

Descriptive statistics and sex difference analyses for the AQ, MSI-BPD, and HADS for Study 2 are presented in Table 3. As with Study 1, AQ total scores were significantly higher for men than women. When examining AQ subscales, statistically significant differences were observed for Details/Patterns and Communication/Mindreading, but not for Social Skills. Contrary to our predictions and to the findings of Study 1, there were no sex differences for BPD traits or HADS anxiety. Also contrary to our predictions but consistent with the data from Study 1, there was no sex difference for HADS depression.

We observed positive correlations between MSI-BPD scores and AQ total scores in both women and men, mirroring our findings from Study 1. We also found that similar effects were present for the three AQ subscales, although in each case, these were smaller in magnitude (Table 4). Contrary to our predictions, though consistent with our findings from Study 1, the strength of these correlations did not differ significantly between men and women (see Table 4 and Fig. 2). To better understand the nature of the association between autistic traits and BPD traits, we created a correlation heatmap by correlating each of the 10 items of the MSI-BPD with each of the 50 items of the AQ (Fig. 3). Instead of coding the AQ items in a binary (0 or 1) fashion, in this case, we instead utilised an alternative scoring system (0, 1, 2, or 3) that is commonly used in the literature (English et al., 2020). This allowed for greater variability in scores for individual items, and, hence, more nuance to the data. Visual examination of Fig. 3 does not reveal any obvious domain-specificity regarding which aspects of the AQ and MSI-BPD are positively correlated.

6.3. Multiple linear regression analysis

We conducted an exploratory multiple linear regression analysis ($n = 699$) with MSI-BPD total score as outcome, AQ Social Skills, AQ Details/Patterns, AQ Communication/Mindreading, Sex, AQ Social Skills × Sex, AQ Details/Patterns × Sex, and AQ Communication/Mindreading × Sex as predictors, and age, HADS anxiety, and HADS depression as covariates (note that interaction terms were calculated based on centred AQ subscale scores). However, as with Study 1, we encountered issues with heteroscedasticity ($p < .001$), non-normality of residuals ($p < .001$), and multicollinearity (AQ Social Skills: VIF = 11.37, tolerance = 0.09; AQ Details/Patterns: VIF = 10.28, tolerance = 0.10; AQ Communication/Mindreading: VIF = 11.51, tolerance = 0.09; AQ Social Skills × Sex: VIF = 11.30, tolerance = 0.09; AQ Details/Patterns × Sex: VIF = 10.17, tolerance = 0.10; AQ Communication/Mindreading × Sex: VIF = 11.61, tolerance = 0.09). Removing the interaction terms from the model resulted in acceptable VIF (all <2.5) and tolerance statistics (all >0.40). The model fit the data well, $F(7, 691) = 98.06$, $p < .001$, and

Table 3
Descriptive statistics and sex differences (Study 2).

	Overall sample			Women			Men			Comparison			
	n	M	SD	n	M	SD	n	M	SD	t	df	d	p
AQ total	700	20.22	7.43	355	19.61	7.63	345	20.85	7.18	−2.222	697.28	−0.168	0.027
AQ social skills	700	6.28	3.93	355	6.19	3.95	345	6.38	3.92	−0.652	697.73	−0.049	0.515
AQ details/patterns	700	3.38	2.07	355	3.13	2.05	345	3.64	2.06	−3.309	697.12	−0.250	< 0.001
AQ communication/mindreading	700	1.83	1.78	355	1.70	1.75	345	1.97	1.79	−2.033	696.00	−0.154	0.042
MSI-BPD	700	3.03	2.87	355	3.10	2.94	345	2.95	2.80	0.695	697.72	0.052	0.487
HADS anxiety	700	6.61	4.79	355	6.83	4.77	345	6.38	4.81	1.246	697.05	0.094	0.213
HADS depression	700	5.01	4.28	355	4.78	4.02	345	5.25	4.52	−1.449	683.62	−0.110	0.148

Note. AQ, Autism Spectrum Quotient; HADS, Hospital Anxiety and Depression Scale; MSI-BPD, McLean Screening Instrument for Borderline Personality Disorder.

Table 4

Correlations between autistic traits and borderline personality traits in men and women (Study 2).

	Women			Men			Comparison		
	r	df	p	r	df	p	z	p	q
AQ total	0.479	353	<0.001	0.404	343	<0.001	1.228	0.219	0.093
AQ social skills	0.359	353	<0.001	0.272	343	<0.001	1.274	0.203	0.097
AQ details/patterns	0.296	353	<0.001	0.175	343	0.001	1.690	0.091	0.128
AQ communication/mindreading	0.282	353	<0.001	0.324	343	<0.001	−0.609	0.543	−0.046

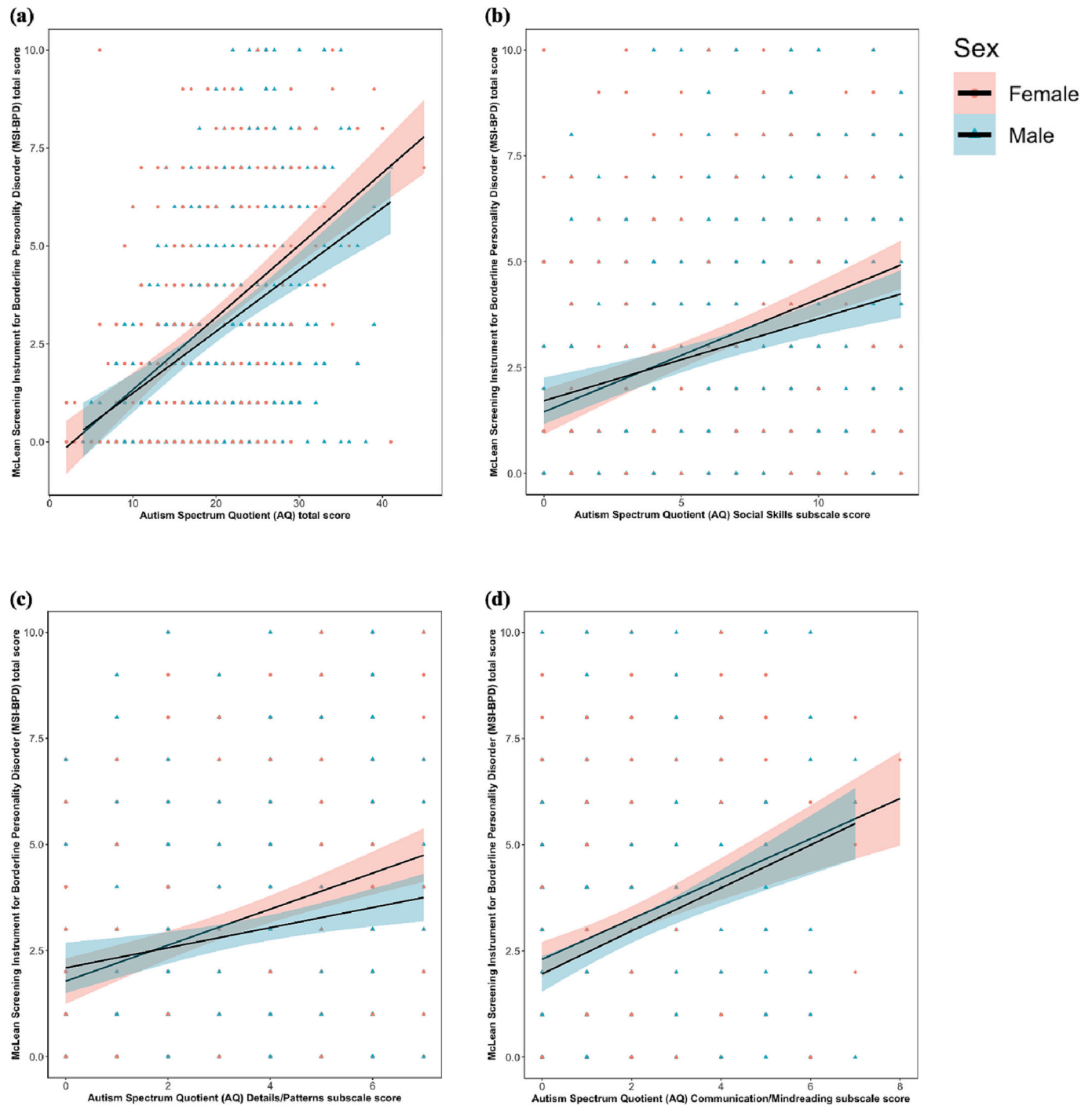Note. AQ, Autism Spectrum Quotient.

Fig. 2. Scatterplots showing correlation between MSI-BPD total score and (**a**) AQ total score (**b**) AQ Social Skills, (**c**) AQ Details/Patterns, and (**d**) AQ Communication/Mindreading, stratified by sex (Study 2).
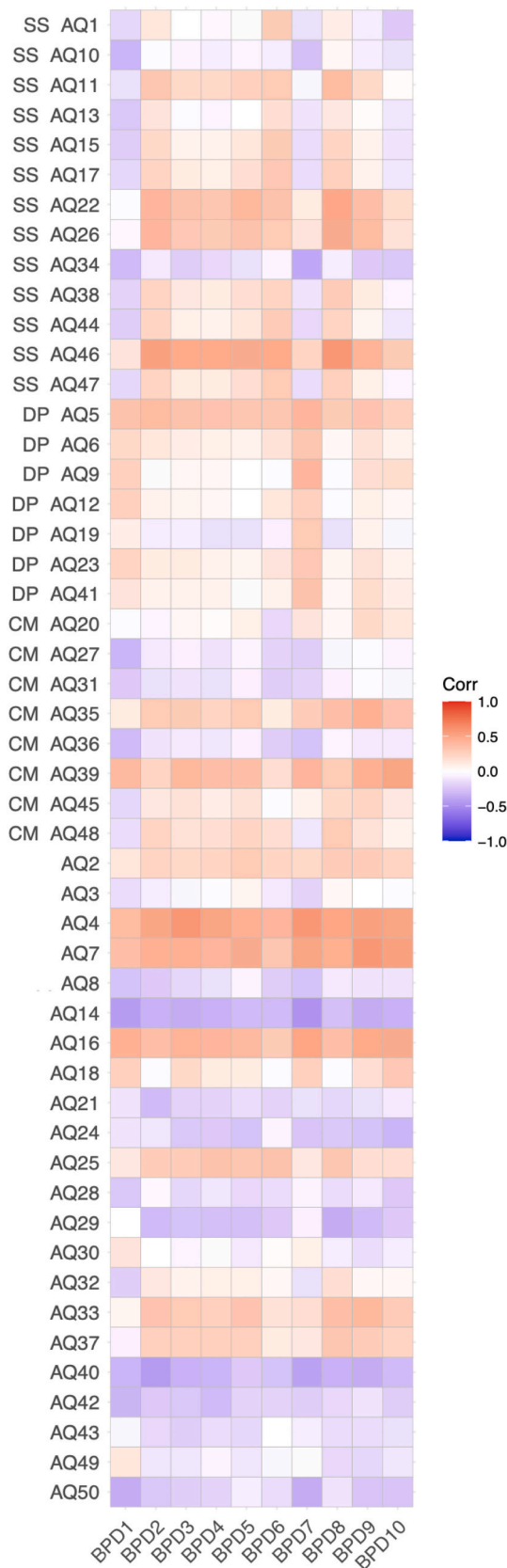
Fig. 3. Correlation heatmap for individual items of the AQ and MSI-BPD (Study 2).
Note. AQ, Autism Spectrum Quotient; CM, Communication/Mindreading; DP, Details/Patterns; SS, Social Skills; BPD, McLean Screening Instrument for Borderline Personality Disorder.

predicted ~49 % of variance (adjusted $R^2 = 0.49$). However, although error was independent between predictors (Durbin-Watson = 2.006, $p = .966$), there remained significant heteroscedasticity ($p < .001$) and non-normality of residuals ($p < .001$).

Due to the above issues, although not pre-registered, we utilised the approach taken in Study 1 by computing bootstrapped (10,000 resamples) multiple linear regression analyses for the total sample ($n = 699$) and for women ($n = 354$) and men ($n = 345$) separately (Table 5). In each case, AQ Details/Patterns and AQ Communication/Mindreading remained significantly positively correlated with MSI-BPD scores, whereas AQ Social Skills did not. As with Study 1, high MSI-BPD scores were associated with age (younger), anxiety (higher) and depression (higher); the effect of sex was also significant, with women having higher MSI-BPD scores than men.

7. Study 2 discussion

Study 2 partially replicates the findings of Study 1 in a US sample. As with Study 1, there was a sex difference for AQ, with men, on average, having higher scores than women. However, whereas Study 1 observed higher MSI-BPD scores in women than men at the univariate, but not multivariate, level, Study 2 observed this effect at the multivariate, but not univariate, level. Replicating Study 1, the hypothesis that autistic and BPD traits co-occur at a greater level than chance was supported. More specifically, MSI-BPD scores correlated positively with AQ total scores and with each of the three subscales examined (Social Skills, Details/Patterns, and Communication/Mindreading) in both men and women. However, and again mirroring findings from Study 1, the strength of correlation between autistic and BPD traits was not moderated by sex. That said, all correlations other than for Communication/Mindreading were numerically stronger in women than men, and that for Details/Patterns would have been considered statistically significant if a one-tailed test had been used. Although this could have been justified because we specified directional predictions a priori, on this

Table 5
Multiple linear regression models with autistic traits variables as predictors and BPD traits as outcome (Study 2).

		β	BCa 95 % CI
Whole sample	Intercept	2.200	1.347–3.040
	AQ social skills	0.00002	−0.044–0.043
	AQ details/patterns	0.154	0.073–0.234
	AQ communication/mindreading	0.168	0.068–0.267
	Sex	−0.331	−0.651 to −0.019
	Age	−0.036	−0.046 to −0.026
	HADS anxiety	0.192	0.140–0.242
	HADS depression	0.179	0.122–0.235
Women	Intercept	2.288	1.365–3.263
	AQ social skills	0.019	−0.045–0.085
	AQ details/patterns	0.190	0.074–0.308
	AQ communication/mindreading	0.161	0.013–0.307
	Age	−0.047	−0.061 to −0.032
	HADS anxiety	0.136	0.065–0.205
	HADS depression	0.231	0.153–0.307
Men	Intercept	1.194	0.288–2.241
	AQ social skills	−0.024	−0.081–0.034
	AQ details/patterns	0.110	0.0001–0.220
	AQ communication/mindreading	0.199	0.064–0.327
	Age	−0.025	−0.039 to −0.012
	HADS anxiety	0.252	0.181–0.323
	HADS depression	0.123	0.044–0.200

Note. The following covariates were included: age, HADS anxiety and HADS depression (all models), and sex (whole sample model only). AQ = Autism Spectrum Quotient; HADS = Hospital Anxiety and Depression Scale; BCa 95 % CI = bias corrected and accelerated 95 % confidence intervals; β = standardized beta coefficient.

occasion, and considering the number of statistical tests employed, it appears sensible to accept the null to avoid undue risk of making a Type 1 error.

English et al. (2020) criticised the use of total AQ scores, as not all latent variables that the measure taps are positively correlated. Interpretation of correlations between total AQ scores and other variables can therefore be difficult to interpret, and a more nuanced approach may provide clearer results. It is, therefore, interesting to note the difference in findings between Study 1 and Study 2 regarding whether an association exists between autistic traits and BPD traits once current levels of anxiety and depression have been considered. Whereas Study 1, which utilised only total AQ scores, found no independent association, Study 2, which instead examined three AQ subscales, found that the positive correlations between BPD traits and both AQ Details/Patterns and AQ Communication/Mindreading remained significant once current symptoms of anxiety and depression had been controlled for statistically.

Like Study 1, Study 2 utilised a large sample size, which was determined a priori, and a pre-registered hypothesis and analysis plan. However, its strength also lies in addressing issues present in Study 1. Whereas a technical error in Study 1 caused one of the MSI-BPD items, as well as the three attention check questions, not to be administered to participants, Study 2 rectified this. Importantly, the 10-item MSI-BPD total score correlated almost perfectly with that calculated from only the first nine items. Furthermore, the very low number of participants that answered attention check questions incorrectly provides assurance that these data collected via Prolific are of high quality. Considering the close similarity between our two studies, these observations therefore increase confidence in the veracity of findings from Study 1 as well as those of Study 2.

8. General discussion

Reports suggest that some women with BPD meet diagnostic criteria for autism (Hofvander et al., 2009; Rydén et al., 2008), though little is known about the underlying processes involved. Our findings replicate Chabrol and Raynal (2018), who reported a positive correlation between autistic and BPD traits in a non-clinical sample. However, although the correlations we observed between MSI-BPD and AQ total scores were stronger in women than men in both the UK (women, $r = 0.336$; men, $r = 0.268$) and US (women, $r = 0.479$; men, $r = 0.404$) samples, neither difference was statistically significant. In fact, very large samples would be required for these differences to be considered significant ($p < .05$) with a two-tailed Fisher's r-to-z test. Assuming a matched number of men and women, $n = 1381$ of each would be required based on the UK effect size estimates, and $n = 891$ of each would be required based on the US effect size estimates. Our findings, therefore, suggest the possible over-representation of autistic women within patient populations with BPD is unlikely to be explained by a markedly stronger association between traits of these conditions occurring in women than men. However, further research is required (May et al., 2021), particularly considering that women with BPD who meet diagnostic criteria for autism may be at increased risk for suicidal behaviour (Rydén et al., 2008).

BPD is complex, with symptom overlap with many other conditions (Fornaro et al., 2016; Sanches, 2019), particularly anxiety and depressive disorders (Tomko et al., 2014). Patients with BPD often present to healthcare services in crisis situations and with intense anxiety and agitation (Shaikh et al., 2017). This has led some to argue that BPD should be conceptualised as an affective disorder (e.g., Köhling et al., 2015). Furthermore, depressive episodes are more persistent and severe in patients with BPD compared to other clinical populations (Gunderson et al., 2008; Yoshimatsu & Palmer, 2014). Although the findings from Study 1 might imply that the positive correlation between autistic and BPD traits can be explained by both being strongly associated with symptoms of anxiety and depression, Study 2 suggests a more nuanced approach should be taken. Whereas Study 1 examined autistic traits only in terms of total AQ score, Study 2 additionally examined subscales

(Social Skills, Details/Patterns, and Communication/Mindreading) derived from the three-factor model of AQ identified by Russell-Smith et al. (2011). Importantly, this model has accrued more empirical support than the myriad alternatives reported in the literature (English et al., 2020). It is, therefore, particularly interesting to note that both AQ Details/Patterns and AQ Communication/Mindreading (but not AQ Social Skills) remained significantly positively correlated with MSI-BPD scores once anxiety and depression symptoms had been controlled for statistically. These findings might suggest a more complex association between autism and BPD than initially thought. They may also stress the utility of examining subscales derived from the AQ rather than only its unidimensional total score. However, even though the subscales examined here have received empirical support, it should be noted that the internal consistency of the Communication/Mindreading subscale was unsatisfactory, both in our Study 2 ($\alpha = 0.638$) and in the original report by Russell-Smith et al. (2011, Study 1) ($\alpha = 0.62$).

Both of our studies presented here benefit from large sample sizes, which were determined a priori via power calculation, as well as pre-registered hypotheses and analysis plans. However, they are also limited by relying on cross-sectional data, meaning that causal inferences cannot be made. Likewise, even though Study 2 is broadly representative of the United States in terms of age, sex, and ethnicity, it should be noted that both our studies examined Western, Educated, Industrialised, Rich, and Democratic (WEIRD; Henrich et al., 2010) samples. It therefore remains unclear whether our findings generalise to other cultures. Further research in this area could utilise longitudinal methods to better explore the emergence and co-occurrence of traits related to mental health and developmental conditions and to examine such processes in non-WEIRD populations.

In conclusion, the current research indicates that autistic and BPD traits are moderately positively correlated within general population adults from the UK and US, and that this correlation is not moderated by sex. It also provides evidence to suggest the association is likely to be independent of current symptoms of anxiety and depression, but for such effects to be detected reliably, researchers may require measures of autistic traits that are more nuanced than total AQ scores.

CRediT authorship contribution statement

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by GR and SK. The first draft of the manuscript was written by GR and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Datasets and R code used to run the analyses in this paper are available on the Open Science Framework (https://osf.io/6tyz3/).

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