

Are PTSD and autistic traits related? An examination among typically developing Israeli adults

Nirit Haruvi-Lamdan^{a,*}, Shiri Lebendiger^a, Ofer Golan^a, Danny Horesh^{a,b}

^a Department of Psychology, Bar-Ilan University, Israel

^b School of Medicine, New York University, United States of America



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ABSTRACT

Background and objectives: Previous research indicates that individuals with Autism Spectrum Disorder (ASD) face an increased risk of experiencing traumatic events. Autistic Traits (AT), characteristic of ASD, are continuously distributed across the general population. Our main objective was to examine the association between AT and PTSD (Post Traumatic Stress Disorder), a topic rarely assessed before.

Methods: One hundred and three college students from 3 academic areas, previously found to be associated with different degrees of AT, completed self-report questionnaires tapping PTSD (the PCL-5; PTSD Checklist for DSM-5), AT (AQ; the Autism Spectrum Quotient), and traumatic life events.

Results: AT were positively associated with all PTSD symptom clusters, except for avoidance. The association between imagination difficulties and PTSD was moderated by gender. Among participants meeting the PTSD cutoff, those with the highest AT levels reported a PTSD symptomatic profile with an increased dominance of hyper-arousal symptoms.

Conclusions: The AT-PTSD association reported here may be attributed to several factors, including increased victimization associated with AT, as well as shared vulnerability factors for both conditions, including impairments in social cognition. Further research is needed in order to understand the associations between these two conditions, considering gender differences, and possible shared underlying mechanisms.

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1. Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental condition, characterized by marked, pervasive and persistent impairments in communication, social skill and relations, accompanied by restricted and repetitive behaviors and interests [1]. Individuals with ASD face an increased risk of experiencing traumatic events and being significantly affected by them [2]. It is well documented that those with ASD suffer from high rates of psychiatric co-morbidity, with ADHD, anxiety disorders and depression being the most commonly diagnosed [3]. Interestingly, the examination of ASD-PTSD co-morbidity has been almost completely neglected. The four studies conducted so far have focused mostly on children and adolescents, rather than adults. These studies vary in sample size, methodology, and findings, making it difficult to draw clear conclusions [3,4,5,6]. One potential way to gain a better understanding of the association between ASD and PTSD is through an examination of autistic traits in typically-developing adults.

Autistic traits (AT), also known as “broad autism phenotype” or “subthreshold autism”, are representations of ASD characteristics, which have been shown to continuously distribute across the general population [7], with people diagnosed with ASD positioned at the extreme end of this distribution [8]. These traits, which are qualitatively similar to features of autism, were initially described in family members of children with autism, and show etiological similarities with ASD [9]. Growing evidence suggests that those with increased AT, even without a formal ASD diagnosis, are more prone to additional mental disorders. Nonetheless, they do not seem to receive enough clinical attention [10]. Studies in non-clinical samples have shown that AT were positively associated with symptoms of depression and anxiety [11]. AT were also positively associated with a higher incidence of bullying [12] and with a history of physical and sexual abuse [13]. Roberts and colleagues have reported that higher levels of PTSD symptoms following childhood abuse were associated with elevated AT levels in adulthood, among female nurses [14]. In addition, an association between PTSD and AT was found among patients with fibromyalgia, most of which were female. Furthermore, increased AT were reported in patients with PTSD compared to those with partial PTSD or without PTSD [15]. Finally, in a study examining parents of pediatric patients with epilepsy,

* Corresponding author at: Department of Psychology, Bar-Ilan University, Ramat-Gan 5290002, Israel.

E-mail address: Danny.Horesh@biu.ac.il (N. Haruvi-Lamdan).

correlations between PTSD symptoms and AT were found only among fathers, but not mothers [16].

There is by now also reason to believe that individuals with ASD may manifest symptoms of post-traumatic stress in a distinct manner, compared to typically-developing individuals. Studies have shown that individuals with ASD show distinct symptomatology in response to stressful and traumatic events, including more somatic complaints, increased anger and hyperactivity [17]. However, to date, no systematic attempt has been made to examine the possibility of a specific PTSD phenotype associated with ASD.

This study aimed to examine the association between AT and PTSD symptoms in a non-clinical adult population. We hypothesized that a positive association would be found between the two, at both the total score level and sub-scales level. In addition, this is the first study to examine whether the symptomatic profile of PTSD may be different among those high in AT compared to those low in AT.

2. Methods

2.1. Participants and procedure

Participants were 103 Israeli college students, 48 males and 55 females, aged 18–34 (M = 23.91, SD = 3.46). They were recruited, via ads, from several academic institutions, located in various areas of the country. Participants represented three academic fields that previously found to differ, on average, on AT levels [18]: psychology (n = 38), business administration (n = 32), and exact sciences (n = 33). All participants were informed about the study and provided written informed consent before the study. All participants completed self-report questionnaires during a face to face meeting with a member of the research team. Participants were compensated for their time.

2.2. Measures

2.2.1. Socio-demographic background

Participants were presented with a variety of background questions assessing socio-demographic factors, including date and place of birth, family status, socio-economic status, and religiosity.

2.2.2. The Autism-Spectrum Quotient (AQ) [18]

The AQ has been used extensively as a quantitative measure of autistic traits in the general population. It comprises 50 items, grouped into five theoretically-driven domains: social skill difficulties, communication difficulties, attention switching difficulties, attention to detail, and limited imagination. Participants rate to what extent they agree or disagree with each statements on a 4-point Likert scale ranging from 1 (“definitely agree”) to 4 (“definitely disagree”). Thus, the AQ score ranges between 50 and 200. Alternatively, using a binary scoring system (0 or 1), scores range between 0 and 50 and a cutoff score of 26 or above is applied to determine the clinical significance of symptoms [19]. The AQ was found to have good diagnostic validity [18]. In the current study, the AQ has shown good internal consistency (Cronbach’s alpha = 0.81).

2.2.3. Stressful and traumatic life events list

As a first step, participants were asked to note events, which they have experienced during their lifetime. The measure includes a comprehensive list of potential traumatic events drawn from the PTSD UCLA Index [20], such as war, a serious accident, terrorism, life-threatening medical illness, and more. In addition, we have added potentially-traumatic inter-personal events, such as bullying and social ostracism. Those events have been found to be particularly distressing for individuals with ASD [21], and are also known in the trauma literature as possible generators of PTSD symptoms [22]. As a second step, participants were asked to note which event caused them the most significant distress.

2.2.4. PTSD Checklist for DSM-5 (PCL-5), Specific Version [23]

The PCL-5 is a self-report questionnaire measuring PTSD symptoms in the preceding month. Items correspond directly with the 20 PTSD symptoms appearing in DSM-5 [1]. The PCL-S (specific) asks about symptoms in relation to an identified stressful experience. Participants were asked to complete the PCL-5 while referring to the event, which they chose as the most distressing, from the life events list. The self-report rating scale is 0–4 for each symptom (from “Not at all” to “Extremely”). The PCL-5 yields a total score, a score for each symptom cluster and a probable PTSD diagnosis according to a cutoff score of 38. The PCL-5 was shown to have very good psychometric properties [23]. Several years ago, the PCL-5 was translated to Hebrew using the back-translation procedure by two PTSD experts with extensive knowledge in PTSD diagnosis. Since its translation, the Hebrew version has been used in several Israeli PTSD studies, showing excellent psychometric properties [24]. In the current study, the instrument has shown excellent internal consistency (Cronbach’s alpha = 0.94).

3. Results

Table 1 presents the sample’s sociodemographic characteristics. As can be seen, the majority of participants were Jewish, single and born in Israel.

3.1. PTSD, trauma exposure and AT

In our sample 4.9% (n = 5) met criteria for probable PTSD, according to formal DSM-5 criteria. A much higher probable PTSD rate (20.4%, n = 21) was found when applying the PCL-5 cutoff score of 38. Eight participants (7.8%) met the AQ cutoff score of 26. Due to the very small number of participants passing the AQ cutoff, all analyses were based on a different AQ categorization, comparing those in the highest AQ quartile (26.2%, n = 27) to those in the three lowest quartiles (73.8%, n = 76). No sociodemographic differences were found between participants in the highest AQ quartile and those in the three lower AQ quartiles.

Almost all participants (98.06%, n = 101) reported being exposed to at least one potentially traumatic event during their lifetime. The mean number of events was eight (SD = 5.04, range = 0–27). A gender difference was found in the rates of exposure to potentially traumatic events (t(101) = 2.57, p < .05), as males reported more events (M = 9.33, SD = 4.6) compared to females (M = 6.83, SD = 5.11). No gender difference was found in PTSD prevalence according to the PCL cutoff.

Table 1
Sample background characteristics.

	% (n)
Gender	
Male	46.6% (48)
Female	53.4% (55)
Discipline	
Psychology	36.9% (38)
Business administration	31.1% (32)
Exact sciences	32% (33)
Country of birth	
Israel	92.2% (95)
Other	7.8% (8)
Religion	
Jewish	92.2% (95)
Muslim	3.9% (4)
Christian	3.9% (4)
Family status	
Married	10.7% (11)
Single	80.6% (83)
In a relationship	8.7% (9)
Income	
Below average	21.4% (22)
Average	12.6% (13)
Above average	66.0% (68)

A marginally significant difference in rates of exposure to potentially traumatic events was found between individuals in the highest AQ quartile ($M = 9.6, SD = 5.34$) compared to individuals in the lower three AQ quartiles ($M = 7.32, SD = 4.87; t(98) = -1.98, p = .051$). A significant gender difference in mean AQ scores was also found, with males ($M = 17.79, SD = 5.99$) scoring higher than females ($M = 15.2, SD = 5.9; t(101) = 2.2, p < .05$).

3.1.1. The association between PTSD and AT

As hypothesized, a significant positive association was found between AQ total score, PCL total score and PCL symptom clusters scores, excluding the avoidance cluster. A significant positive association was found between PCL total score and two AQ sub-scales: social skill and communication (see Table 2).

Additionally, 40% of participants in the highest AQ quartile met the PCL cutoff for PTSD, compared to only 14.7% among those in the 3 lower AQ quartiles ($\chi^2(1) = 7.253, p < .01$).

Next, a Multivariate Analysis of Variance (MANOVA) was conducted, with total number of traumatic life events (exposure level) as a covariate, gender and PTSD probable diagnosis (above/below the PCL cutoff) as the independent variables, and AQ total score and sub-scale scores as the dependent variables. The MANOVA showed a significant main effect for PTSD probable diagnosis ($F(5,94) = 4.62, p < .001, \eta^2 = 0.20$). Compared to those without probable PTSD, participants who met the PTSD cutoff score reported a higher AQ total score ($F(1,98) = 17.52, p < .001, \eta^2 = 0.15$), as well as higher scores on the majority of AQ sub-scales: social skill ($F(1,98) = 10.58, p < .01, \eta^2 = 0.10$), attention switching ($F(1,98) = 14.17, p < .001, \eta^2 = 0.13$), and communication ($F(1,98) = 19.52, p < .001, \eta^2 = 0.17$). A marginally significant main effect was found for gender ($F(5,94) = 2.27, p = .053, \eta^2 = 0.10$). Compared to females, males reported a higher AQ total score ($F(1,98) = 5.87, p < .05, \eta^2 = 0.06$), and a higher AQ score in attention switching sub-scale ($F(1,98) = 7.14, P < .01, \eta^2 = 0.07$) and in communication sub-scale ($F(1,98) = 8.1, p < .01, \eta^2 = 0.08$). The multivariate analysis also yielded a significant interaction between PTSD and gender ($F(5,94) = 2.4, p < .05, \eta^2 = 0.11$). A univariate interaction analysis showed that the source of this effect was a gender X PTSD interaction for the AQ imagination sub-scale ($F(1,98) = 5.29, p < .05, \eta^2 = 0.05$; see Fig. 1). While among those without probable PTSD males reported increased AQ imagination limitations, compared to females, among those with probable PTSD, females reported increased AQ imagination limitations, compared to males. Additionally, a marginally significant interaction was found for the AQ attention switching sub-scale ($F(1,98) = 3.7, p = .057, \eta^2 = 0.036$). Among males, those with probable PTSD showed increased AQ attention switching difficulties compared to those without probable PTSD, but no such difference was found for females.

Finally, logistic regression results showed that female gender ($OR = 0.236, 95\% CI [0.066-0.835], p < .05$), higher AQ total score ($OR = 1.208,$

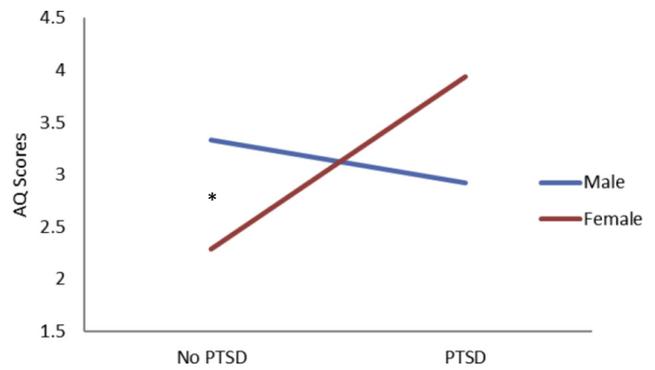


Fig. 1. PTSD X Gender interaction for AQ imagination sub-scale AQ = The Autism Spectrum Quotient, PTSD = Post-Traumatic Stress Disorder, * $p < .05$.

95% CI [1.089–1.340], $p < .001$), and higher number of potentially traumatic life events ($OR = 1.137, 95\% CI [1.015-1.274], p < .05$) significantly increased the odds of having a probable PTSD diagnosis. Together, the model explained 31.6% of the variance, $\chi^2(3) = 23.09, p < .001$.

3.1.2. PTSD symptomatic profile

In order to examine the symptomatic profile of PTSD among those with high levels of AT, we analyzed only those who have met the PCL cutoff for PTSD. We examined the composition of PTSD symptoms, i.e., which cluster yields the highest relative scores among those in the highest quartile of AQ scores ($n = 10$) compared to those in the three lower quartiles ($n = 11$). Table 3 shows means and SDs for all PTSD clusters in both groups.

In order to examine the significance of within-group differences between cluster scores, we employed the Wilcoxon Signed Rank Test. The analysis revealed a somewhat different PTSD symptom composition for those high and low on AT. More specifically, while the symptom patterns related to intrusion, avoidance and negative mood and cognition were quite similar among both groups, hyper-arousal symptoms were relatively more dominant among those in the highest AQ quartile.

Table 3
Means (St. Dev.) of PTSD symptom cluster scores by AQ group.

AQ Group	PTSD clusters			
	Intrusion	Avoidance	Negative mood and cognition	Hyperarousal
Highest quartiles	10.9 (3.96)	4.8 (1.69)	16.42 (4.62)	13.4 (2.76)
Lower quartiles	10.45 (3.36)	5.45 (1.29)	16.18 (3.74)	11.36 (3.17)

Table 2
Pearson correlations between AT and PTSD.

PCL AQ	Re-experiencing	Avoidance	Negative alteration in cognition and mood	Hyperarousal	Total
Social skill	0.251*	0.121	0.424**	0.279**	0.339**
Attention switching	0.058	0.005	0.240*	0.259**	0.191
Attention to details	0.258**	0.128	0.098	0.132	0.169
Communication	0.168	0.147	0.362**	0.328**	0.310**
Imagination	0.188	0.044	0.187	0.140	0.175
Total	0.291**	0.137	0.406**	0.356**	0.369**

AT = Autistic Traits, AQ = The Autism-Spectrum Quotient, PTSD = Post Traumatic Stress Disorder, PCL = The PTSD Checklist for DSM-5.

* $p < .05$.
** $p < .01$.

Thus, among those in the highest AQ quartile, hyperarousal symptoms were significantly higher than both intrusion ($Z = -2.03, p < .05$) and avoidance ($Z = -2.81, p < .01$) symptoms. However, among those in the three lower quartiles, the difference between hyperarousal symptoms and intrusion symptoms was not significant ($Z = -0.256, p = .79$). The relative dominance of hyperarousal among the highest AQ quartile group was also evident in the fact that its level did not significantly differ from that of the negative mood and cognition cluster ($Z = -1.79, p = .074$), which overall showed the highest scores of all clusters. This was not true for the lower AQ quartiles group, where hyperarousal was significantly lower than negative mood and cognition ($Z = -2.81, p < .01$).

4. Discussion

This preliminary study aimed to assess the association between autistic traits (AT) and PTSD symptoms among typically-developing Israeli adults. Our findings indicated a positive association between PTSD symptoms and AT, which was moderated by gender for AT imagination and partly for attention switching. Our results also reveal the possibility of a PTSD symptomatic profile characterized by enhanced hyper-arousal for those with high AT.

Our main finding, showing a positive association between AT and PTSD symptoms, may have various explanations. AT may be associated with less adaptive coping strategies during and after exposure to traumatic events [25]. Moreover, AT were found to be associated with increased threat perception, which, in turn, is often pivotal in the development and persistence of post-traumatic symptoms [26]. Furthermore, communication deficits may get in the way of reporting traumatic experiences, and seeking help or treatment. Finally, we have found a marginally-significant association between AT level and of the degree of trauma exposure. This hints at the possibility that the PTSD-AT association is also mediated by greater trauma exposure, as AT may render individuals more vulnerable to assault, abuse and social stressors. Further research is necessary in this area.

It may be more reasonable to assume that AT are the precursor of PTSD, rather than the other way around. One might argue that traits are by definition core psychic constructs, often affecting one's reactions to stress [27]. It should be noted, however, that our study is correlative, and therefore causality cannot be inferred. Thus, another possibility is that existing PTSD may increase the severity of AT, rather than vice versa. Garcia-Villamisar and Rojahn, for example, suggested that increased stress and other psychopathologies comorbid with ASD may increase the frequency and intensity of repetitive and stereotyped behaviors in autistic adults [28]. Furthermore, difficulties in interpersonal relationships and attentional bias are common consequences of PTSD, which, in turn, may increase AT manifestation. Additionally, Dell'Osso and colleagues suggested that PTSD symptoms may, for example, increase feelings of detachment and isolation from others. Such feelings may closely resemble AT and raise AQ scores [13]. A third possibility is that there are shared underlying mechanisms that may play a role in both PTSD and ASD independently. These may include difficulties in emotion regulation, increased rumination and reduced specificity of autobiographical memory [29].

Interestingly, although avoidance is a common characteristic among individuals with ASD [30], PTSD avoidance symptoms were the only ones not associated with any AQ sub-scale. A possible explanation may be that the items representing the avoidance cluster in the PTSD questionnaire specifically refer to avoidance of traumatic reminders, as opposed to the highly generalized, stable, and idiosyncratic type of avoidance that often characterizes individuals with ASD. Looking at specific AT domains, we found that impaired social skills were related to almost all PTSD symptoms (except avoidance). Thus, social aspects seem central in this association. Individuals with high levels of AT tend to be more socially isolated [31], and may lack the social support networks that have been shown to protect or buffer the effects of traumatic

exposure. Additionally, the tendency to focus attention on details was specifically associated with re-experiencing symptoms. This is consistent with a study conducted by Hageñaars and colleagues [32], which found an association between reduced global preference, i.e., relative increased focus on local stimuli, and subsequent PTSD re-experiencing symptoms.

The association between PTSD symptoms and the AQ sub-scale of imagination was moderated by gender. While among those without probable PTSD males reported increased imagination limitations compared to females, among those with probable PTSD females reported increased imagination limitations compared to males. The AQ imagination sub-scale items refer to abstraction, symbolization, pretend play, and Theory of Mind (ToM) abilities. It was previously found that one's imagination and ability to engage in fantastical worlds are positively associated with ToM abilities [33]. Previous studies revealed that, in general, females performed better on ToM tasks [34]. This finding is consistent with our results, among those without PTSD. The report of diminished imagination abilities in females with a probable PTSD could therefore be interpreted in one of two directions: One, is that females, more than males, rely on imagination skills in order to effectively cope with traumatic event. Hence, when this ability is compromised, e.g., in the case of females with high AT, the susceptibility to PTSD increases. The positive association found in females between imagination abilities and emotion regulation skills [35], may support this direction. Alternatively, it is possible that in the context of trauma imagination abilities, particularly those related to the social domain, are more strongly compromised among females than among males. For example, Nazarov and colleagues studied females who were exposed to childhood abuse, and found deficits in ToM performance among those with PTSD compared to healthy controls [36]. However, a study of male Vietnam combat veterans has shown that those with PTSD did not differ from those without PTSD on symbolization abilities [37]. Thus, perhaps males and females experience different deficits in response to trauma, a notion that is in line with current knowledge about the complex gender-specific pathways to distress following adversity [38].

Additionally, a marginally significant finding in this study indicated that the association between PTSD symptoms and the AQ sub-scale of attention switching was stronger among males compared to females. Feng et al. examined sex differences in visual attention switching, and found an advantage for females in several aspects [39]. Difficulties in attention switching are associated with lack of cognitive flexibility, emotional dysregulation, and rumination, and thus may be directly or indirectly associated with PTSD symptoms [40]. Further research is needed to explore this mechanism, as it may indicate different therapy targets for males and females. This gender effect is particularly interesting, given the opposite directionality of gender-related vulnerability in PTSD and ASD. PTSD is twice more common in females than among males [41], while a gender ratio of between 2 and 4 males to 1 female characterizes ASD [42]. These findings highlight the need for further studies investigating the unique, gender-specific pathways to PTSD-AT comorbidity.

In light of recent efforts to categorize PTSD into specific subtypes [43], and the growing understanding that individuals with the same diagnosis may show distinct symptom manifestations [44], we have found differences in the PTSD symptom composition between those high and low in AT, with the former showing a PTSD clinical picture where hyperarousal was relatively more dominant. This may be attributed to several factors. First, this PTSD cluster holds strong similarities and overlaps with anxiety symptoms, which are quite common among the ASD population [45]. Additionally, the relative dominance of hyper-arousal may be related to sensory hyper-responsivity, which is a defining characteristic of ASD [1]. Sensory hyper-responsivity may alter the perception and interpretation of stressful situations and render them more threatening for the individual. Thus, those showing this sensitivity may become overly aware of their surroundings, and adopt a more hypervigilant stance. Moreover, sensory hyper responsivity has

been associated with anxiety disorders [46] and with sleep problems in individuals with ASD [47]. Thus, autonomic arousal may be a dominant pathway for the expression of post-traumatic stress among those high in AT.

This preliminary study has several limitations, including a moderate sample size of college students, and a reliance on self-report measures. In addition, in this study we have made an a-priori decision to move beyond the strict DSM-5 definition of traumatic events (i.e., criterion A for PTSD), thus allowing participants to report their PTSD symptoms in response to a wide variety of events, including social stressors. This may have somewhat inflated the rates of PTSD found here.

Despite these limitations, the present study sheds important light on a possible association between PTSD and AT – a topic that was very rarely studied before. In an era where post-traumatic co-morbidity seems to be the rule rather than the exception, and where trans-diagnostic approaches are the focus of great attention, the complex associations between autistic features and PTSD merit much more research, not only in the context of AT but also among those diagnosed with ASD on a clinical level. We believe such examinations would eventually enable improved diagnosis and treatment among individuals with ASD who are exposed to trauma.

Conflict of interests

The authors declare that they have no conflicts of interests.

Ethics approval

All participants were informed about the study and provided written informed consent before the study. The study was approved by the Bar-Ilan University research authority, the Institutional Review Board.

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