



Are there gender differences in sensory sensitivity and ASD characteristics in emerging adults?

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Abstract

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by deficits in social communication/interaction and restricted, repetitive patterns of behaviour. Sensory processing abnormalities, including hyper- and hyposensitivity, are a symptom under the latter diagnostic criterion. This study investigated gender differences in ASD traits and sensory sensitivity (hyper- and hyposensitivity) in emerging adults, addressing the underexplored area of gender differences in ASD prevalence and presentation within this age group. A convenience sample of 112 emerging adults (ages 18-25) was recruited, including 17 men and 95 women. Participants completed the Autism Spectrum Quotient-Short (AQ-Short) to assess ASD traits and the Adolescent/Adult Sensory Profile (AASP) to evaluate sensory sensitivity. No significant gender differences were found in overall ASD traits or hyposensitivity. However, women scored significantly higher than men in hypersensitivity ($p < .001$, $d = .88$). Although no significant association was found between ASD traits and hypersensitivity, a regression analysis indicated that higher ASD traits were associated with increased hypersensitivity ($p < .001$, $sr = .61$), regardless of gender. No interaction effect was found between gender and ASD traits on sensory sensitivity. The findings of this study contribute to a more nuanced understanding of gender differences in ASD traits and sensory sensitivity.

Keywords: Autism Spectrum Disorder, sensory sensitivity, hypersensitivity, hyposensitivity, emerging adults

Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder with a combination of deficits in social communication/interaction and restricted, repetitive patterns of behaviour (American Psychiatric Association [APA], 2013). It is estimated that 1% of children around the world is diagnosed with ASD (Zeidan et al., 2022), whereas the prevalence rate among adults in the United States is estimated at 2.21% (Dietz et al., 2020). In the review of Zeidan and colleagues (2022), it was noted that the male-to-female ratio ranged from 0.8 to 6, with males consistently outnumbering females. It has been demonstrated that adolescents with ASD face significant challenges in daily living skills (e.g. hygiene, meal preparation, money management, etc.), and it has been proposed that this can impact the transition to adulthood (Glover et al., 2023). The DSM-V notes “hyperreactivity or hyporeactivity to sensory input, or unusual interests in sensory aspects of the environment” as one of the symptoms of ASD under the criterion of restricted, repetitive patterns of behaviour, interests or activities (APA, 2013). These terms are otherwise phrased as hyper- and hyposensitivity, which respectively mean increased sensitivity to sensory stimuli and diminished ability to detect sensory stimuli.

Sensory processing is the receiving, organizing, and interpreting of a sensory stimulus. Sensory stimuli refer to anything that is perceived by any of our five senses (sight, smell, hearing, taste, touch) plus the internal sensory systems, i.e. the proprioceptive (lets us perceive the location and movements of our body parts), vestibular (provides the sense of balance and information about body position), and interoceptive (lets us feel what is happening inside our body) systems. The processing of and reaction to sensory stimuli are different for each individual. Dunn (2007) developed the Four Quadrant Model of Sensory Processing, centred on two key concepts, i.e. neurological thresholds and behavioural response. The neurological threshold reflects an individual's sensitivity to sensory stimuli, ranging from low to high. Low thresholds lead to quick responses because the systems are

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easily activated, while high thresholds may result in less responsiveness. The second concept, behavioural response, considers passive to active strategies in environmental interactions. Passive individuals may internally respond but not actively change their surroundings, while active individuals actively control sensory input. For example, someone with a low neurological threshold and passive response may be overwhelmed by the noise around them, but does not take action to get out of the situation (i.e. sensory sensitivity), while someone with a low neurological threshold and an active response may leave the room when they are overwhelmed by the sounds (i.e. sensation avoiding). On the other hand, someone with a high neurological threshold and passive response may miss sensory stimuli that others notice easily (i.e. low registration), while someone with a high neurological threshold and active response may look for situations with a lot of stimuli (i.e. sensation seeking). Taken together, the sensory processing profiles 'sensory sensitivity' and 'sensation avoiding' make up the hypersensitivity scale, while 'low registration' and 'sensation seeking' together make up the hyposensitivity scale. Overall, each person has unique thresholds and behavioural responses to sensory stimuli (Dunn, 2007).

Previous research has found all of Dunn's four sensory quadrants to be elevated across children with ASD (Little et al., 2018). Moreover, teens with an autism spectrum condition (ASC) have reported sensory sensitivity that is outside normal parameters (Howe & Stagg, 2016). This sensory sensitivity was reported to be largely negative and affecting learning in school. Even in individuals without an official ASD diagnosis, higher scores on ASD traits have a significant positive correlation with the frequency of sensory processing problems (Robertson & Simmons, 2012).

Gender differences in ASD and sensory responsivity

The occurrence of Autism Spectrum Disorder (ASD) differs between genders, as is observed in many neurodevelopmental conditions (Loomes et al., 2017). ASD seems to be

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notably more prevalent in men than women, with an overall reported prevalence ratio of 4:1. However, this does not necessarily indicate that there are less women with ASD than there are men with the disorder. One of the reasons ASD goes unnoticed in women is that women may not always exhibit behaviours that are commonly associated with ASD in the general population (e.g. Hiller et al., 2014). Concerning behavioural features, compared to men with ASD, it has been shown that women exhibit better reciprocal conversation, are more likely to share interests, integrate verbal/nonverbal behaviour, and to adjust their behaviour by situation, despite having comparable social understanding issues as men (Hiller et al., 2014). Women also show different types of special interests which tend to involve people/animals rather than objects, which may be less recognized as related to ASD, even though they remain unusual in intensity. Moreover, repetitive behaviours may be observed less in women than in men (Lai et al., 2015). Furthermore, it has been indicated that women with ASD engage in “camouflaging” (i.e. masking their autistic traits) more than men (Cruz et al., 2024). This variation in ASD traits can impact the diagnosis process, potentially leading to biases (Mandy et al., 2012). Moreover, as has been stated by Dworzynski and colleagues (2012), women are less likely than men to meet diagnostic criteria for ASD at equivalently high levels of ASD traits. This could add to the lower levels of diagnoses in women.

In addition to ASD traits, the differences between men and women in sensory sensitivity has previously been researched. For example, in a study by Öberg and colleagues (2002), it was found that women have a superior episodic odour memory, which is mediated by their higher proficiency in odour identification. In a different research project, two studies were done on pressure pain threshold (PPT; Chesterton et al., 2003). Women showed a lower threshold for pain in both studies. Furthermore, women have shown that they are more sensitive to auditory stimuli (McFadden, 2014). In a study by Simcoe et al. (2022), it was found that girls with ASD, in comparison to boys with ASD, exhibited higher scores in

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sensory sensitivity. Moreover, sensory sensitivity was identified as a distinguishing factor between neurotypical girls and girls with ASD in this same study. In another study, it was found that girls with ASD show significantly more atypical responses to sensory stimuli compared to boys (Osório et al., 2021). The findings of this study indicate that girls with ASD may have a higher likelihood of avoiding or experiencing distress from certain auditory stimuli. They might tend to withdraw from noisy environments or get distracted by sounds that go unnoticed by others. Discrepancies in the Balance and Motion subscale of the sensory processing measure (SPM) and SPM – Preschool (SPM-P) imply that girls with ASD could encounter more challenges in movement coordination and postural control than boys with ASD (Osório et al., 2021). Differences like these carry significant implications for understanding the profiles of autism in women, ultimately enhancing the potential for earlier detection, diagnosis and treatment. Furthermore, a research by Mayer (2017) revealed a distinct progression of atypical sensory behaviours that align with an increase in autistic traits, irrespective of the individual's diagnostic status. This suggests that the relationship between sensory behaviours and autistic traits is consistent and observable across a spectrum of individuals, not limited to those with a formal ASD diagnosis.

Present study

In the present study, the differences between men and women on ASD traits and hypo- and hypersensitivity, as well as the relationship between these variables will be investigated in emerging adults. By studying the experience of sensory perceptions in men and women, more insight can be gained on the differences, potentially eventually leading to easier diagnosis of ASD in women. Furthermore, it is of importance to investigate the experience of ASD traits and sensory reactivity in emerging adults, as this population is underrepresented in research. It is important to acknowledge how ASD manifests itself in this group, as it is a period characterized by the transition to independence, and the brain is still developing. Research on

sensory sensitivity can help identify specific sensory-related challenges that may arise during this transition, influencing factors such as employment, higher education, and independent living. This way, these individuals their needs can be understood, and this can help in tailoring support. The study will employ a dimensional approach to examine ASD in the general population of emerging adults. The findings are based on data derived from self-reports.

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Given the previously found evidence that men are more often diagnosed with ASD (Dworzynski et al., 2012; Loomes et al., 2017), it is expected that men will have higher scores of ASD traits compared to women in this study. Furthermore, based on previous research outcomes (e.g. Osório et al., 2021), it is hypothesized that women will have higher scores of hypersensitivity compared to men, while men score higher on hyposensitivity compared to women. Lastly, based on existing literature (e.g. Mayer, 2017), it is expected that higher levels of ASD traits will be related to higher levels of abnormal sensory processing (i.e. hyposensitivity or hypersensitivity), and that this effect will differ based on gender (Cardon et al., 2023; Simcoe et al., 2022).

Methods

Participants

The data were collected based on a convenience sample, as participants were recruited through the researchers' social network (e.g. personal contacts, social media). In the end, the total amount of participants who completed the questionnaire was 127. Some specific inclusion and exclusion criteria were taken into account. The research question was aimed at emerging adults, meaning that the age of the participants had to lie between 18 and 25 years. Participants under the age of 18 ($n = 0$) and over the age of 25 ($n = 5$) were excluded from further analyses. Potential sensory issues (e.g. loss of hearing) were considered and asked

about in the questionnaire. Participants were excluded if such a sensory issue was accompanied by an outlying score on hyper- or hyposensitivity ($n = 0$). Lastly, since this research is comparing scores between men and women, only those responding to the question “What gender do you identify as?” with ‘man’ or ‘woman’ were included in the analyses.

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Participants who responded with ‘other’ were excluded from further analyses ($n = 2$). Participants who answered at least two out of four of the validity questions (see Procedure) incorrectly, were excluded ($n = 10$). After implementing these criteria, 112 cases were left to analyse. General characteristics of the participants are shown in Table 1. The average age of the participants was 22.9 years ($SD = 1.6$). Seven of the participants (6.3%) were previously diagnosed with ASD. There were no significant differences between the genders on any of the reported characteristics. Every individual gave informed consent to participate in the research. The participants did not receive any compensation for their participation.

Materials

To assess autistic traits, the Dutch shortened version of the Autism Spectrum Quotient was used (AQ-Short; Hoekstra et al., 2011). This questionnaire consists of 28 items (e.g. “I find myself drawn more strongly to people than to things”). The items are evaluated using a four-point Likert scale, spanning from 1 = 'strongly agree' to 4 = 'strongly disagree'. For items where an 'agree' response typically signifies autism (13 out of 28 items), the scoring is recoded. The scores of individual items are added together, yielding an AQ score ranging from 28 (no autistic traits) to 104 (full expression of measured autistic traits).

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The AQ-Short consists of two main factors evaluating 'challenges in social behaviour' and 'interest in numbers/patterns'. In the present study, however, no distinction was made between these factors. Instead, the total score of the items was used. The AQ-Short serves as a valuable substitute for the complete 50-item version, as it has high specificity and sensitivity (Baron-Cohen et al., 2001; Hoekstra et al., 2011). Moreover, the AQ-Short

Table 1
 General Characteristics of the Participants

Characteristic	Men				Women			
	<i>n</i>	%	<i>M</i>	<i>SD</i>	<i>n</i>	%	<i>M</i>	<i>SD</i>
Age	17	15.2			95	84.8		
Highest finished education			23	2			22.9	1.6
Vocational education	1	5.9			1	1.1		
Secondary education	5	29.4			28	29.5		
Tertiary education	7	41.2			52	54.7		
Scientific Master's degree	3	17.6			14	14.7		
Other	1	5.9			0	0		
Previous diagnosis								
ASD	1	5.9			6	6.3		
Other psychiatric disorders	1	5.9			19	20		
Neurological disorders	0	0			4	4.2		

Note. *M* = Mean. *SD* = Standard Deviation. ASD = Autism Spectrum Disorder.

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correlates very highly (r between .93 and .95) with the full-scale AQ (Hoekstra et al., 2011).

To assess sensory sensitivity, the Dutch version of the Adolescent/Adult Sensory Profile was used (AASP; Brown et al., 2007). The AASP evaluates sensory sensitivity, utilizing Dunn's Model of Sensory Processing. It comprises 60 items, distributed across six sensory processing modalities: taste/smell ($k = 8$, e.g. "I don't smell things other people do smell"), movement ($k = 8$, e.g. "I stumble and bump into things"), vision ($k = 10$, e.g. "I like to visit places with bright lights and many colours"), touch ($k = 13$, e.g. "I like to walk barefoot"), activity level ($k = 10$, e.g. "I find it difficult to continuously concentrate during a lengthy class or meeting"), and auditory processing ($k = 11$, e.g. "I startle easily from unexpected or loud noises"). Participants assess each item on a five-point Likert scale, ranging from 1 = 'almost never' to 5 = 'almost always'. Each item belong to one of the four quadrants, namely low registration ($k = 15$), sensation seeking ($k = 15$), sensory sensitivity ($k = 15$), and sensation avoiding ($k = 15$). The AASP demonstrates Cronbach's alphas ranging from 0.64 to 0.70 for internal consistency across the four quadrants within the 18–64 age group, which is deemed satisfactory (Brown et al., 2007).

Procedure

The study was approved by the Ethics Committee of Psychology at the University of Groningen (PSY-2223-S-0515). Online data collection took place between the 15th of November and the 28th of November, 2023. Since the questionnaire was online, the participants could fill it in when and where it suited them. Before the participants were asked any questions, they were fully informed about the nature of the study, their role in it, the potential risks, and their right to withdraw at any time without any repercussions. Only after consenting to participate, they could fill in the survey. The survey started off with some general characteristics items, such as age, gender, level of education, and occurrence of psychiatric and neurological diagnoses. Four validity questions were included in the questionnaire, in which participants had to fill in a specific answer, assuring the researchers that the questions were being read carefully. In the end, the participants who answered at least 3 out of 4 questions correctly were included. In addition to the ASQ and AASP, several questionnaires were included in the survey as part of another overarching study. The total time to complete the survey was 20 to 30 minutes.

Statistical Analysis

SPSS version 28.0.1.1 was used for data analysis. A p value of < 0.05 was considered statistically significant. Before any tests were carried out, the assumptions pertaining to these tests were assessed. No violations were found. The sum scores of the AQ-Short (*ASD traits*) were computed, as well as the z -scores of this variable. Furthermore, the items of the hyposensitivity and the hypersensitivity subscales of the AASP, respectively, were grouped together into two new variables (*Hyposensitivity* and *Hypersensitivity*), and the sum scores of these variables were computed as well. Lastly, an interaction variable was computed by multiplying the z -score of *ASD traits* by *gender*.

To examine whether men and women differ in ASD traits, an independent samples t-test was performed with *ASD traits* as dependent variable and *Gender* as independent variable. To examine whether the genders differ in sensory sensitivity, the mean total numbers of reported hypo- and hypersensitivity symptoms were also compared between men and women using an independent samples t-test, with either *Hyposensitivity* or *Hypersensitivity* as dependent variable and *Gender* as independent variable. To quantify the magnitude of the observed effects, Cohen's *d* was calculated. A value of 0.2 is seen as a small effect size, 0.5 is a moderate effect size, and 0.8 is a large effect size.

To investigate the effect of ASD traits on hypo- and hypersensitivity, zero-order (Pearson) correlations were investigated. Lastly, to examine whether an effect of the interaction between gender and ASD traits on hypo- and hypersensitivity was present, linear regression analyses were performed, where *Hyposensitivity* or *Hypersensitivity* was the dependent variable, and *ASD traits*, *Gender*, and *ASD traits* × *Gender* were the independent variables. To assess the magnitude of the observed effects, semi-partial correlations were calculated.

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Results

Regarding gender differences in *ASD traits*, men ($M = 62.5$, $SD = 10.9$) and women ($M = 60.6$, $SD = 13$) did not significantly differ, $t(110) = -.557$, $p = .579$, $d = 0.15$. There was no significant difference in *Hyposensitivity* between men ($M = 73.3$, $SD = 8.3$) and women ($M = 77.9$, $SD = 10.4$), $t(110) = 1.7$, $p = .084$, $d = 0.46$. Furthermore, women ($M = 76.4$, $SD = 18.9$) scored significantly higher than men ($M = 60.5$, $SD = 12$) in *Hypersensitivity*, $t(110) = 4.6$, $p < .001$, $d = .88$.

The relationship between ASD traits and hyposensitivity shows a correlation that is almost negligible ($r(110) = -.02$, $p = .829$). In the regression analysis with *Hyposensitivity* as

dependent variable, the independent variables together did not statistically significantly predict the dependent variable ($R^2 = .03$, $F(3, 108) = 1.13$, $p = .341$). There were no significant effects of *ASD traits* ($t(108) = 0.08$, $p = .937$, $sr = .008$), *Gender* ($t(108) = -1.63$, $p = .11$, $sr = -.16$), nor *ASD traits* × *Gender* ($t(108) = -0.61$, $p = .542$, $sr = -.06$).

The relationship between ASD traits and hypersensitivity shows a moderate correlation ($r(110) = .58$, $p < .001$). In the regression analysis with *Hypersensitivity* as dependent variable, the independent variables together statistically significantly predicted the dependent variable ($R^2 = .45$, with $F(3, 108) = 29.39$, $p < .001$). There was a significant effect of *ASD traits* ($t(108) = 8.08$, $p < .001$, $sr = .61$) and of *Gender* ($t(108) = -4.60$, $p < .001$, $sr = -.40$), but not of *ASD traits* × *Gender* ($t(108) = -0.58$, $p = .566$, $sr = -.06$). This shows that hypersensitivity level increases when there is a higher level of ASD traits, and when someone is a woman.

Discussion

In this study, the difference between women and men on ASD traits, hyper- and hyposensitivity, and the interaction between these variables were investigated. In this group of 112 emerging adults, the most apparent difference between genders was found on the hypersensitivity scale, where women scored higher than men. However, no significant gender differences were observed in hyposensitivity or total amount of ASD traits. A moderate correlation was found between ASD traits and hypersensitivity. No interaction effects were found of ASD traits and gender on hypersensitivity nor hyposensitivity.

Although the expectation was to find higher scores in men, there was no difference found in ASD characteristics between men and women in the present study. This outcome has been reported before, for example in a study by Grove and colleagues (2017), where no difference was found between men and women with ASD on the mean total score of ASD

characteristics as measured by the AQ-Short. Several findings can be considered to explain this outcome. For one, it has been suggested that due to the noted gender disparity in ASD prevalence, it is possible that the standard portrayal of ASD is biased towards men (Kirkovski et al., 2013), and that this is reflected in the diagnostic measurements, as most studies on the identification and characteristics of ASD have relied on convenience samples from clinical settings, which disproportionately represent men (Thompson et al., 2003). This would give us reason to suspect that men score higher on ASD traits than women. However, the current study used a non-biased measurement tool. Recently, Belcher et al. (2023) conducted a study examining gender biases in different versions of the AQ. In the AQ-Short version that was used in this study, they observed a number of 19 biased items. However, these were almost equally distributed, with 9 items more likely to be endorsed by men and 10 items more likely to be endorsed by women. This means that this questionnaire might not be as biased towards men as other questionnaires that measure ASD characteristics, which could be a reason for similar scores of ASD traits.

On the other hand, it should be considered that these 'biases' could also be reflecting the different expressions of ASD between the genders, as more attention has been directed towards this concept in the past few years (e.g. Cardon et al., 2023). In the present study, only the total amount of ASD characteristics was compared between the genders. Perhaps differences in ASD characteristics would have been found if the different types of characteristics (e.g. social skills, routines, imagination) had been examined instead.

Lastly, findings on gender differences in individuals with ASD are complex and can be subject to variation based on factors such as intellectual characteristics (de Giambattista et al., 2021). It is possible that gender differences are less apparent in highly educated/intelligent individuals. The current sample consists of mostly well-educated individuals, as 64.7% of the men and 69.4% of the women in the sample would be considered

‘highly educated’ (Centraal Bureau voor de Statistiek [CBS], 2021), and 29.4% of the men and 29.5% of the women in the sample would be considered ‘intermediately educated’. Moreover, none of the women included in the study reported having an intellectual disability. According to Saure and colleagues (2023), in individuals with ASD and an intellectual disability (ID), women appear to experience more severe effects of ASD compared to men, while in individuals with ASD but without ID, women may exhibit fewer symptoms than men. Furthermore, it has been reported that girls are less likely than boys to meet diagnostic criteria for ASD at equivalently high levels of autistic-like traits when they do not have additional intellectual or behavioural problems (Dworzynski et al., 2012). In yet another study, it was found that above-average verbal IQ seemed to supply protection against social communication impairments in women but not in men (Skuse et al., 2009). Taken together, the fact that none of the women in the present study have an intellectual disability could mean that their scores would be higher if they did, in which case there could have been a difference in ASD characteristics between genders, albeit in the opposite direction than was hypothesized.]

In the current study, no effect of gender was found on hyposensitivity. This could mean that hyposensitivity is not much affected in emerging adults. However, so far, not many studies have included the difference between hyper-and hyposensitivity, instead opting to investigate only the broader concept of ‘sensory sensitivity’. One of the studies that did include this distinction, was done by Cardon and colleagues (2023). In their study, men showed higher hyposensitivity scores than women. An explanation for the difference in findings between that study and the current one could be that the current study used a different measurement tool. Cardon and colleagues used the Glasgow Sensory Questionnaire (GSQ; Robertson & Simmons, 2013) instead of the AASP to measure sensory symptoms. The difference between these questionnaires is that the GSQ was initially constructed based on

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Commented [MZ14]: Doordat de GSQ is gebaseerd op de ervaringen van vrouwen met ASD, is het mogelijk om de validiteit van deze questionnaire in twijfel te trekken op de huidige onderzoekspopulatie aangezien hier een groot deel uit vrouwen bestaat die hierdoor niet goed gerepresenteerd worden wat de validiteit discabel is. Hiervoor zal meer onderzoek voor moeten worden gedaan in hoeverre deze questionnaire effectief is op het beoordelen van een ASD op vrouwen

reports of common sensory signs and symptoms associated with ASD, whereas the AASP was constructed based on Dunn's Model of Sensory Processing.

Although no significant gender differences were found in hyposensitivity, women indicated considerably higher hypersensitivity than men (large difference). Heightened sensitivity to sensory stimuli in women compared to men has been noted in research multiple times before (e.g. Osório et al., 2021; Simcoe et al., 2022). The studies by Simcoe and colleagues (2022) and Osório and colleagues (2021) included participants who were children with ASD and the parents of children with ASD (who reported about the symptoms of their children), meaning that this result is not limited to emerging adults. In another recent study, the difference in sensory processing between neurotypical men and women was examined in participants who were between 19 and 26 years of age (Cardon et al., 2023). They also found that hypersensitivity was enhanced in women. To this author's knowledge, this is the only study done to date that included a similar sample as the present study. The present study, therefore, expanded the support that has thus far been found on the difference in hypersensitivity between genders in this specific age group.

One possible explanation for this phenomenon is that men and women with ASD differ in the neurobiology underlying sensory over-reactivity. This was examined by Cummings and colleagues (2020), who showed that relative to women with ASD, men with ASD presented a stronger association between sensory over-responsivity (SOR) and increased connectivity between the salience network (SN; thought to help direct attention to the most relevant stimuli in one's environment) and primary sensory network. This would suggest increased allocation to sensory information. On the other hand, for women with ASD, SOR was more strongly related to increased connectivity between the SN and prefrontal cortex. It has been suggested that this increased activity in prefrontal areas in women

compared to men with ASD could mean that they extend more effort toward regulating negative emotions in relation to aversive sensory stimuli (Cummings et al., 2020).

In the present study, no effect of ASD characteristics on hyposensitivity was observed. Some of the studies concerning this topic have found different results. One of them is by Jussila and colleagues (2020), who described that children without ASD had significantly higher scores on the Autism Spectrum Screening Questionnaire (ASSQ), which measures ASD traits, when they showed heightened auditory, tactile, or visual hyposensitivity. In addition, it has been observed that hyporesponsiveness appears more prevalent and specific to ASD than hyperresponsiveness during early childhood (Baranek et al., 2006). Furthermore, it has been observed that hyporesponsivity is able to distinguish children with ASD from neurotypically developing children (Baranek et al., 2006), as well as children with other neurodevelopmental conditions (Watts et al., 2016). In the latter study, chronological age was identified as a factor that reduces variability in these findings. This means that there could be an effect of age on the relationship between ASD characteristics and hyposensitivity, which could explain the lack of effect in the present study, which included emerging adults. In the present study, no difference between men and women was found on this outcome.

In the present study, a main effect was found of ASD characteristics on hypersensitivity, meaning that higher scores on ASD characteristics are associated with higher scores on the hypersensitivity scales, regardless of gender. Sensory sensitivity has been shown to be positively correlated to the amount of ASD characteristics before. However, these studies do not make a distinction between hypo- and hypersensitivity. For example, in a study by Robertson and Simmons (2013), a highly significant positive correlation was found between number of autistic traits and frequency of sensory processing problems in the general population. Moreover, this study used the GSQ instead of the AASP. Horder and colleagues (2014) replicated these findings using the GSQ, the AASP, and the Cardiff

Anomalous Perception Scale (CAPS). They reported a similar relationship between autistic traits and sensory atypicalities, although with a lower level of significance. Furthermore, Mayer (2016) found that the strength and pattern of the relationship between autistic traits and sensory functioning does not differ between neurotypical and adults with ASD.

Atypical patterns of sensory responsiveness have been linked to the core features of restrictive, repetitive behaviours (RRBs) and social communication in individuals with ASD (Feldman et al., 2020). For example, Boyd and colleagues (2010) found that high levels of hyperresponsive behaviours predicted high levels of repetitive behaviours in children, and that this relationship remained the same after controlling for mental age. Moreover, they did not find this relationship between hyporesponsive behaviours and repetitive behaviours (Boyd et al., 2010), although this effect was later found in a different study (Feldman et al., 2020). Schulz and colleagues (2019) also found that hypersensitivity is strongly related to repetitive behaviours in children, as well as adolescents. They added to this that the same effect was found for neurotypically developing individuals. Feldman and colleagues (2020) also found that hyperresponsiveness as well as hyporesponsiveness and sensory seeking were significantly correlated with social communication difficulties in children and adolescents with ASD compared to neurotypically developing children and adolescents. It is possible that in the current study, the heightened amount of ASD characteristics may be due to higher scores on the categories of RRBs and social communication. Although this was not investigated, it could mean that these effects are consistent across different ages.

Whereas in this study no interaction effect has been found between gender and number of ASD traits on the extent of sensory hyper- and hyposensitivity, this has previously been found in other research. In the study by Cardon and colleagues (2023), a significant correlation was found between autistic traits (measured on the AQ) and sensory sensitivity (i.e. hypo- and hypersensitivity combined; measured on the GSQ) for both men and women.

In addition, a significantly stronger correlation between autistic traits and hypersensitivity was found in women compared to men when measuring the ASD characteristics with the Broader Autism Phenotype Questionnaire (BAPQ). Again, due to the different questionnaires being used, it might not be completely comparable to the present study. On the other hand, this study was the only one to date using a target group similar to the present one, with individuals aged 19-26 years, which makes it more comparable.

Limitations

While the findings of this study contribute to our understanding of gender differences in ASD characteristics and sensory sensitivity in emerging adults, it is important to take into account several limitations that may impact the interpretation and generalizability of the results. In this sample, the prevalence of ASD diagnoses was higher than the worldwide prevalence. The total prevalence in the current sample was 6.25%, while it has been established that the global prevalence is 0.6% (Salari et al., 2022). Moreover, although it has been established that men are diagnosed more often in the worldwide population (Loomes et al., 2017), that was also not the case in this sample, with 5.9% ($n = 1$) of the men having an ASD diagnosis, as opposed to 6.3% ($n = 6$) of the women. As the sample thus does not seem very representative of the population, a decrease of generalizability of the results could be a consequence.

Secondly, due to the relatively low number of men included in the present study, there may have been a loss of power, which could have influenced the results of the statistical tests. However, to solve this problem, it was important to look at the effect sizes of the tests. As there were no contradicting results between p values and effect sizes, it is more likely that the effects that were found reflect the true effects in the population, rather than being a result of insufficient power.

Another limitation of the present study is that only the total amount of ASD traits were compared between genders, and the subcategories of symptoms were not looked into.

As gender differences might emerge in specific areas of ASD characteristics, the focus on total scores might have obscured such differences.

Furthermore, the sample consisted predominantly of well-educated individuals, which could limit the generalizability of the findings. As intellectual characteristics may influence the manifestation of ASD traits (de Giambattista et al., 2021), the high education level in this sample might have masked potential gender differences in ASD characteristics, particularly as none of the women reported an intellectual disability.

Implications and directions for future research

The findings of this study have several important implications for both clinical practice and future research. As this is, to this author's knowledge, one of the first studies on the differences in sensory sensitivity and ASD characteristics between 18 to 25 year old men and women, it is important that more research is done on the subject to be able to conclude anything with any certainty. It is recommended that the same research is done on a larger and more proportionate sample, in order to reduce potential power issues. Furthermore, it may be interesting to study the differences between men and women of different cultural backgrounds and socioeconomic statuses, as different cultural contexts might have varying norms and expectations, which could impact how these traits are expressed and perceived.

The lack of focus on hyposensitivity in research so far suggests that more research is needed to explore gender differences in this domain. Hyposensitivity may manifest differently across developmental stages or under certain conditions, and future studies should investigate these potential factors to better understand its role in ASD.

Sensory processing patterns might change as individuals (with ASD) age, and these changes could affect diagnosis and treatment approaches. Longitudinal studies and age-specific assessments would help refine our understanding of how sensory sensitivities evolve over time. Furthermore, it is of importance to look at the different types of ASD symptoms

and their relation to sensory sensitivity. By looking at the different symptoms instead of only the total number of ASD characteristics, the varying struggles of men and women on the spectrum can be further dissected. These are just some examples of future research that could help us contribute to a more nuanced understanding of ASD and sensory processing in emerging adults.

Conclusions

The present study examined the extent to which there are differences between genders on ASD characteristics and hypo- and hypersensitivity. No evidence was found for a difference in amount of ASD characteristics between men and women. Furthermore, this study did not indicate a difference in hyposensitivity levels between men and women. On the other hand, support was found for heightened levels of hypersensitivity in women compared to men. More ASD characteristics was related to higher hypersensitivity, but not to hyposensitivity. These relationships did not differ between genders. The findings of this study contribute to a more nuanced understanding of gender differences in ASD traits and sensory sensitivities, particularly in emerging adults.

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