“Utterly Overwhelming” – A Mixed-Methods Exploration of Sensory Processing Differences and Mental Health Experiences in Middle-aged and Older Autistic Adults

Community Brief (508 words)

“Why is this an important issue?”
Autistic people often experience sensory processing differences (SPDs), e.g., difficulties with sound/noise, textures, tastes, smells, and temperatures. Additionally, these SPDs often impact their mental health. While these SPDs are not unique to autistic people, they experience SPDs at higher rates than the general population.

“What was the purpose of this study?”
People of all ages can experience SPDs and mental health conditions. Despite this, much of the existing research on sensory and mental health experiences has focused on young autistic people. This study aimed to explore these experiences in middle-aged (age 40-59) and older (age 60+) autistic people.

“What did the researchers do?”
Using an online survey, we asked middle-aged and older autistic and non-autistic adults questions about their experiences of SPDs and their mental health. A total of 265 autistic and 167 non-autistic adults aged 40-93 took part in our survey. About half of our sample were women.

“What were the results of the study?”
Compared to the non-autistic participants, the autistic people in our study reported more SPDs, a higher frequency of overwhelming sensory experiences, and lower abilities to cope with their sensory experiences as they aged. SPDs and mental health conditions were found to co-occur, and this was reported more often by older autistic participants. In the open-text responses, autistic and non-autistic people reported that noise was a particular issue, but autistic people were more likely to stress the impacts on their mental health than non-autistic people. Several autistic people mentioned that they had developed coping strategies for managing their sensory experiences, for example wearing noise-canceling headphones.

“What do these findings add to what was already known?”
These findings further our understanding of the experience of sensory processing differences in autistic populations. Much of the existing research has focused on younger people, and these findings highlight that middle-aged and older autistic people may need additional support for managing their sensory environments as they get older. It also highlights that sensory experiences should be considered when supporting autistic people with their mental health, and this may be particularly important for older autistic people.

“What are potential weaknesses in the study?”
First, our findings are based on cross-sectional data, and thus we are unable to generate predictive relationships between SPDs and mental health conditions. Second, the subscale used to measure the presence of SPDs only included three items. Third, most current participants are from the UK and very few non-binary/trans/genderfluid individuals took part in this study. Last, there may also be other factors that are influencing the SPDs of middle-aged and older autistic adults that aren’t taken into consideration in this study, for example their physical health or their living situation.

“How will these findings help autistic adults now or in the future?”
These findings highlight that autistic people in midlife and older age may be particularly susceptible to sensory processing differences, which may impact their mental health. This emphasizes the need for evidence-based interventions to address sensory processing differences and support autistic people with their sensory environments as they age.

"Utterly Overwhelming" – A Mixed-Methods Exploration of Sensory Processing Differences and Mental Health Experiences in Middle-aged and Older Autistic Adults

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ABSTRACT

Background: Sensory processing differences (SPDs) and mental health symptoms are not limited to young autistic people but continue to occur into adulthood. However, existing quantitative research has predominantly focused on younger autistic people. Less work has been done to investigate SPDs and relationships with mental health conditions in older autistic adults (i.e., aged 40 and above) across their midlife and older adulthood.

Methods: 432 participants (autistic *n*=265; non-autistic *n*=167) aged 40-93 years completed online questionnaires related to SPDs and mental health (i.e., anxiety and depression symptoms). Neurotype and gender differences, age associations, and associations between SPDs and mental health were examined. Participants' contextualization of their lived experiences of SPDs was analyzed qualitatively.

Results: Overall, SPDs and mental health symptoms were more apparent in the autistic group than the non-autistic group, with autistic women showing higher levels of SPDs and poorer mental health than autistic men. SPDs were more often reported to worsen across adulthood by those in the autistic group than those in the non-autistic group, with older autistic people more often reporting worse coping abilities. Furthermore, positive associations between SPDs and anxiety/depression symptoms were observed in the autistic group, with the strength of associations increasing with age. From the qualitative data, we developed six topics reflecting participants' lived experience of SPDs.

Conclusion: Quantitative and qualitative evidence suggest that autistic adults in older age may be more likely to have a heightened risk of SPDs and associated poorer mental health. This study extends previous understanding of SPDs with mainly younger autism populations and highlights the necessity of exploring sensory difficulties in autistic adults in midlife and older adulthood.

INTRODUCTION

Sensory processing differences (SPDs) are characterized as the mismatch between external contextual stimuli and internal information processes across sensory domains, which are presented as hypersensitivity, hyposensitivity, sensation seeking, etc.[1,2] The estimated prevalence of SPDs among autistic people varies between studies, ranging from 30% to over 96%.[3-6] The existing empirical evidence suggests that many SPDs observed among young autistic people are still pervasively present in adulthood[7-10] across a wide range of public environments.[11]

Despite SPDs being common in autistic adults, it remains unclear how SPDs change with age across midlife (age 40-59) and older (age 60+) adulthood. By comparing SPDs across sensory domains, Kern and colleagues[12,13] found that SPDs in their sample of autistic people from infancy to 56 years old were observed to become more similar to non-autistic people with age, suggesting a reduction in SPDs from childhood to middle adulthood. Such lessening of SPDs across the adult lifespan was also documented by Hwang et al[14] and across childhood and middle-adulthood by Leekam et al[15]. However, Crane et al[16] observed no significant correlations between age and levels of SPDs in autistic adults.

These conflicting findings point to the necessity of considering the age range in each study when interpreting and comparing aging effects on SPDs. For example, both Kern et al[12,13] and Leekam et al[15] included autistic people aged from pre-school to midlife, which may be less likely to reflect how SPDs develop over adulthood. Although several studies[10,14,16] have focused on autistic adults, participants were mostly middle-aged, with older autistic adults being underrepresented. Therefore, despite an emerging body of literature investigating SPDs among autistic people, fewer studies have examined sensory experiences throughout adulthood.[17] The development of SPDs in older age (i.e., aged 40 and above) has yet to be specifically explored in autistic populations.

Sensory processing difference is one of the assumed influencing factors of autistic mental health throughout childhood and adulthood. Mental health conditions in autistic populations are widely documented to persist into older age, with significantly higher rates of psychiatric conditions (e.g., depression, anxiety, OCD) being found in older autistic people (and older people with high autistic traits) than in age- and gender-matched non-autistic comparison groups.[18,19] The positive associations between SPDs and mental health challenges, such as anxiety and depression symptoms, have been

evidenced in numerous empirical studies. To take anxiety as an example, Syu and Lin [20] and Verhulst et al[21] examined the relationship between self-reported sensory reactivity and anxiety with groups of autistic adults aged 20-39 (mean age=28) and 18-76 (mean age=42) years, respectively. Sensory avoiding,[20] hypersensitivity, hyposensitivity, and sensory seeking[21] were all found to be positively correlated with anxiety symptoms. Furthermore, this relationship was qualitatively addressed, with autistic adults reporting that uncomfortable mental states and emotions (e.g., being agitated, anxious, upset, stressed) could affect their abilities to process sensory stimuli (e.g., entering a busy environment) and be exacerbated by unwanted sensory input (e.g., temperature and smell of an environment).[10,22] Although both quantitative and qualitative evidence support the existence of an association between SPDs and mental health in autistic adults, previous studies did not address any changes with age. Whether there is a stronger or weaker association between SPDs and mental health in midlife and older autistic people remains unclear.

In addition to the level of SPDs, autistic people's abilities to cope and manage SPDs can influence how the perception of certain sensory stimuli is experienced, affecting mood and emotions.[10,22,23] For example, autistic adults with visual sensitivities reported the relaxing nature of using colored overlays and lenses, which can improve their mood.[23] However, there is a lack of quantitative evidence for how SPDs coping abilities relate to mental health symptoms in older autistic adults (i.e., aged 40 and above).

To summarize, despite previous empirical evidence suggesting that SPDs are not limited to young autistic people but continue to occur into autistic adulthood, existing quantitative research has predominantly focused on autistic children,[24] adolescents,[25] or young adults.[26] This has resulted in a lack of evidence with autistic adults, especially those in middle and older age (i.e., age over 40 years). In the current study, we aimed to extend our understanding of SPDs over autistic adulthood from three perspectives. First, we simultaneously focused on three aspects of SPDs: the presence of SPDs across the lifespan; the current frequency of overwhelming SPDs; and the change in coping ability for SPDs during adulthood, to gain further insights into the SPDs in midlife and older autistic adults. Second, our focus on autistic adults beyond midlife (i.e., age over 40 years) could elucidate how SPDs change throughout autistic middle and later adulthood. Third, to our knowledge, this is the first study to examine the age effect on the strength of association between SPDs and mental health in autistic adults.

To achieve these aims, we will test the following hypotheses:

1. The autistic group will report higher levels of SPDs and mental health symptoms, namely symptoms of anxiety and depression, than the non-autistic comparison group.

2. Stronger associations between levels of SPDs and mental health symptoms (i.e., both increasing) will be observed in the autistic group compared to the non-autistic group.

Gender and age differences will be examined within these hypotheses. Furthermore, open-text information about the lived experiences of SPDs will be analyzed to contextualize these findings.

METHODS

Study Design and Participants

This study uses cross-sectional data from the first wave of the 'Ageing, Wellbeing and Autism' (AgeWellAutism) study, conducted in Spring 2019. The 'AgeWellAutism' study is an online survey exploring aging on the autism spectrum. Participants were recruited through existing participation databases, recruitment notices on Autistica's Research Network and older adult residential/retirement communities, and adverts on social media (e.g., Twitter, Facebook, Reddit). Individuals were eligible to participate if they were over 40 years of age, had access to an internet-enabled device, and could read English. Individuals could take part in this study from any country. The survey was accessed via Qualtrics.

A full information sheet with detailed aims and objectives of the study was presented before the start of the survey. Participants then provided informed consent and were reminded of their right to withdraw at any time. Partial survey responses were discarded. During the survey, participants were presented with a series of demographic questions and standardized questionnaires covering a variety of topics (e.g., autistic traits, a health checklist, mental health symptoms, and quality of life). After completing the survey, participants were provided a full debrief sheet, including links to a range of support services. Participants were entered into a raffle to win one of twenty £20 gift vouchers. Full ethical approval was received for this study through the King's College London PNM Research Ethics sub-committee (HR-18/19-10941).

In total, 432 participants aged 40-93 years completed the online survey. Ninety-eight per cent of the sample were from the UK. The autistic group (*n*=265) included those with an autism diagnosis (*n*=254) and those who self-identified as autistic (*n*=11). The mean age of diagnosis was 50.4 years (*SD*=16.7, range=pre-18 to 84 years). The remaining participants formed a non-autistic comparison group (non-autistic *n*=167). Groups were matched on age (mean age: autistic=60.6 years; non-autistic=60.5 years), gender ratio (men: autistic %=46.8%; non-autistic %=50.3%), and education history (with undergraduate or above qualifications: autistic %=37.0%; non-autistic %=41.9%). Some group differences were found in demographic and clinical characteristics, specifically, autistic participants reported lower rates of employment and higher rates of mental health conditions, e.g., depression and anxiety (Table 1).

[Insert Table 1]

Materials

Demographic characteristics – Participants provided detailed demographic information including age, gender/sex, location, education history, employment status, health history, and whether they have an autism diagnosis or self-identify as autistic.

Self-report measures of Sensory Processing Differences (SPDs)

Presence of SPDs – The Ritvo Autism and Asperger Diagnostic Scale – 14 (RAADS-14)[27] is a short 14-item screener designed to identify adults who may have undiagnosed autism by assessing the presence of autistic characteristics through childhood and adulthood. RAADS-14 explores three subdomains: mentalizing, social functioning, and sensory reactivity. The presence of SPDs in the current study was measured by the sensory reactivity subdomain in the RAADS-14. For all three items in the sensory reactivity subdomain, higher scores suggest the autistic characteristic of sensory reactivity is present throughout childhood and adulthood, for example, "*Some ordinary textures that do not bother others feel very offensive when they touch my skin.*" For each statement, participants are asked to rate whether and when they believe the statement to have been true to them, using a 4-point Likert scale; scores of 0-3 are given for each item (3="True now and when I was young", 2="True only now",1="True only when I was younger than 16", 0="Never true"). Summing item scores creates a possible total sensory reactivity subdomain score of 0-9. In the current sample, the internal consistency (Cronbach's α) of the full RAADS-14 is .89 and .75 in autistic and non-autistic groups, respectively. For the sensory reactivity subdomain, the internal consistency (Cronbach's α) for autistic and non-autistic groups is .70 and .39, respectively.

Perceived frequency of overwhelming SPDs – Using a bespoke question, participants were asked, "*Please think about your sensory experiences (such as sensitivity to noise and light, sensitivity to touch, etc.). How often do you find your sensory experiences to be overwhelming?*". Responses were recorded using a 5-point Likert scale (1="Never" to 5="Always"). Higher scores reflect a higher frequency of overwhelming SPDs.

Perceived change in coping ability for SPDs during adulthood – Using a bespoke question, participants were asked, "*Has your ability to cope with sensory experiences become better or worse over your adult life?*". Responses were phrased as "It has got better", "There has been no change", and "It has got worse".

Contextualizing the lived experience of SPDs - Participants could optionally provide contextualization of their responses to the previous two questions in an open-text box

("*If you would like to tell us more about your sensory experiences, please use the space below to do so")*.

Self-report measures of Mental Health (MH) symptoms

Anxiety - Symptoms of generalized anxiety were measured using the General Anxiety Disorder questionnaire (GAD-7)[28]. The GAD-7 is a seven-item questionnaire with a 4-point scale which asks the participant to report whether they have been bothered by a range of problems over the past two weeks. Using the conventional cut-off score of ≥10, the GAD-7 has a sensitivity of 89% and a specificity of 82% for generalized anxiety disorder. The psychometric properties of the GAD-7 have yet to be validated in autistic populations of any age. In the current sample, the internal consistency of the GAD-7 was acceptable in both autistic (Cronbach's α=.78) and non-autistic groups (Cronbach's α=.74).

Depression - Symptoms of depression were measured using the Patient Health Questionnaire (PHQ-9)[29]. The PHQ-9 is a nine-item questionnaire with a 4-point scale which asks the participant to report whether they have been bothered by a range of problems over the past two weeks. Using the conventional cut-off score of ≥10, the PHQ-9 has a sensitivity of 88% and a specificity of 88% for major depressive disorder. The PHQ-9 has been validated for use with autistic adults.[30]

Data Analysis

All statistical analyses were performed using SPSS version 29.0[31]. Differences between the autistic and non-autistic groups in demographic variables, the presence and frequency of SPDs, anxiety and depression scores, and frequencies of participants passing cut-off scores were analyzed using independent sample *t*-test and chi-square (X^2) tests. Associations between age and other variables were examined using correlation analyses. Multiple regression was used to test the moderating effect of neurotype, gender, age, and anxiety/depression on the strength of associations. Additional 2 X 2 ANOVA and independent sample *t*-tests were conducted to examine gender differences. We collapsed the change in coping ability responses into three categories: 'better', 'same', and 'worse'. Multinomial logistic regression was conducted for the effects of neurotype, age, gender, frequency of SPDs, anxiety, and depression scores on the change in coping ability responses.

We summarized and analyzed open-text responses using content analysis,

which is an objective systematic way of describing and quantifying qualitative data.[32,33] Inductive content analysis was adopted for coding, grouping and generating categories, and describing content topics.[32]

Community Involvement

Prior to the beginning of the AgeWellAutism study in 2019, the research team conducted one-on-one patient and public involvement (PPI) interviews via telephone, email, and instant messaging. In total, 12 middle-aged and older autistic adults were asked about the key factors that influence their quality of life as they get older. The research team then created the AgeWellAutism study survey to address the topics that arose (e.g., mental health, social support networks, and other topics not included in the current study) and provided to three members of the PPI group. Feedback on the accessibility, content, and language use of the survey was collected. Those involved in the PPI consultation process were offered up to two £20 gift vouchers for their participation in the interview and their feedback on the survey.

For the current study, an independent autistic researcher (CAJ) was involved in the analysis and interpretation of qualitative findings and the write-up of this manuscript. CAJ is a late-diagnosed Autistic woman, who also has a diagnosed sensory processing condition. CAJ was paid for her time as a consultant on this project.

RESULTS

Presence of Sensory processing differences (SPDs) (RAADS-14 sensory reactivity subdomain)

Overall, the presence of SPDs measured by the RAADS-14 sensory reactivity subdomain was significantly higher in the autistic group than in the non-autistic, with a large effect size (Table 2). Regarding gender differences, across both autistic and non-autistic groups, the presence of SPDs was greater in women versus men, with small to medium effect sizes (Supplementary Table 1). Due to the small number of non-binary/trans/genderfluid participants (*n*=4), statistical comparisons with this group were not possible.

Considering age and gender associations, significant positive small-to-moderate associations were found between age and the presence of SPDs in autistic men and women, however, a significant negative association was only found for non-autistic women, with no association for non-autistic men. The strengths of these age associations with the presence of SPDs differed; the correlation strength was significantly more positive in autistic men than autistic women, and significantly more negative in non-autistic women than non-autistic men. See Table 2 and Supplementary Table 2 for age correlations by neurotype and by gender.

Frequency of overwhelming SPDs

The autistic group reported a significantly higher frequency of overwhelming sensory experiences than the non-autistic group, with a large effect size (Table 2). There was a significant interaction effect of neurotype and gender on the frequency of overwhelming SPDs, suggesting that non-autistic men and non-autistic women experienced a comparably lower frequency of overwhelming SPDs than the autistic group, but autistic women had more frequent overwhelming SPDs than autistic men (Supplementary Figure 1 and Supplementary Table 1).

Considering age and gender associations, significant positive associations were found between age and the frequency of overwhelming SPDs in autistic men and autistic women, while the negative age association in the non-autistic group was not significant. The strengths of these age associations with the frequency of SPDs did not differ between genders in either autistic or non-autistic groups. See Table 2 and

Supplementary Table 2 for age correlations by neurotype and gender.

Change in coping ability for SPDs during adulthood

There was a significant group difference in the change of ability to cope with sensory experiences ($X^2(2)=66.19$, $p<.001$). Compared to the non-autistic group, a significantly greater proportion of autistic people reported that their ability to cope with their sensory experiences during adulthood had got 'worse' than reported that it had got 'better' ($B=2.34$, $p<.001$, $OR=10.38$) or stayed the 'same' ($B=1.84$, $p<.001$, $OR=6.30$).

Gender differences in the change in coping abilities during adulthood were not found in either the autistic ($X^2(2)=3.04$, $p=.219$) or non-autistic ($X^2(2)=0.39$, $p=.822$) groups. Using multinomial logistic regression, age differences in the change in coping ability to cope with sensory experiences were only found in the autistic group (autistic: $X^2(2)=29.87$, $p<.001$; non-autistic: $X^2(2)=1.17$, $p=.558$). Autistic people who reported that their coping abilities had got 'worse' were significantly older than those who reported that it had got 'better' ($B=-0.08$, $p<.001$, $OR=0.92$) or stayed the 'same' ($B=-0.04$, $p<.001$, $OR=0.96$). See Table 2 and Supplementary Table 3 for change in coping ability responses by neurotype and gender and mean age for participants endorsing each response category.

The difference in the frequency of overwhelming SPDs on the perceived change in coping ability during adulthood was found only in the autistic group (autistic: $X^2(2)=17.33$, $p<.001$; non-autistic: $X^2(2)=0.99$, $p=.609$). Autistic people with more frequent overwhelming SPDs were more likely to report their coping abilities as being 'worse' than 'better' ($B=-0.52$, $p=.005$, $OR=0.60$) or staying the 'same' ($B=-0.49$, $p<.001$, $OR=0.61$). See Supplementary Table 4 for the frequency of overwhelming SPDs in each coping ability category by neurotype.

[Insert Table 2]

Associations between SPDs and MH symptoms

The autistic group had significantly higher anxiety and depression scores than the non-autistic group. Both mental health symptoms were positively associated with age in the autistic group and negatively associated with age in the non-autistic group. No significant gender differences were found in either group. See Table 2 and

Supplementary Tables 1 and 2 for further details.

The presence of SPDs and frequency of overwhelming SPDs were positively and significantly associated with anxiety and depression symptoms in the autistic group, with moderate-to-large coefficients. However, only the association between the presence of SPDs and depression symptoms was significant in the non-autistic group (Table 3). In multiple regression tests, neurotype was found to significantly moderate the relationships between 1) the presence of SPDs and depression symptoms (b=1.11, p=.012, R^2 change=.01), 2) the presence of SPDs and anxiety symptoms (b=0.79, p<.001, R^2 change=.02), and 3) frequency of overwhelming SPDs and anxiety symptoms (b=1.31, p<.001, R^2 change=.02), with associations in the autistic group being significantly greater than in the non-autistic group.

The difference in anxiety symptoms on the change in coping ability during adulthood was found only in the autistic group (autistic: $X^2(2)=6.71$, p=.035; non-autistic: $X^2(2)=2.15$, p=.342). Autistic people with higher levels of anxiety symptoms were more likely to report their coping abilities as having got 'worse' than 'better' (B=-0.15, p=.011, OR=0.86). Change in coping ability during adulthood was significantly related to current depression level for both autistic ($X^2(2)=23.27$, p<.001) and non-autistic groups ($X^2(2)=12.91$, p=.002). Participants with higher levels of depression were more likely to report their coping abilities as having got 'worse' than 'better' (autistic: B=-0.14, p<.001, OR=0.87; non-autistic: B=-0.39, p<.001, OR=0.68) or 'same' (autistic: B=-0.11, p<.001, OR=0.90; non-autistic: B=-0.24, p=.006, OR=0.79). See Supplementary Table 4 for anxiety and depression symptoms in each coping ability category by neurotype.

Regarding gender differences, significant positive associations between SPDs and anxiety/depression symptoms were found in both autistic men and women, with moderate-to-large strength. A significant moderating effect of gender on the strength of association was not observed in the autistic group. In the non-autistic group, the presence and frequency of SPDs were significantly associated with anxiety in non-autistic men, and the presence of SPDs was significantly related to depression in non-autistic women. Gender significantly moderated the association between the presence of SPDs and anxiety (b=-2.27, p=.006, R^2change=.04). See Supplementary Table 5 for associations between SPDs and anxiety/depression symptoms by neurotype and gender.

Age moderated the strength of association between SPDs and anxiety/depression symptoms differently in autistic and non-autistic groups. In the autistic group, the strength of association between the presence of SPDs and depression increased with age (b=0.04, p<*.001*, R^2change=.03). In the non-autistic group, the strength of

association between the frequency of overwhelming SPDs and depression decreased with age (b=-0.02, p=.049, R^2change=.02).

[Insert Table 3]

Contextualizing the lived experience of SPDs (content analysis)

In total, we received 53 open-text responses (12% of the total sample); most of these were provided by autistic participants (47/53; 89%) with only a small number of non-autistic participants (6/53; 11%) responding to the open-ended questions. Of the 47 responses from the autistic group, 16/47 (34%) were from autistic men, 29/47 (62%) were from autistic women, and 2/47 (4%) were from non-binary/trans/genderfluid autistic people. Of the 6 (six) responses from the non-autistic group, 2/6 (33%) and 4/6 (67%) were from non-autistic men and women, respectively. The responses were from both autistic and non-autistic participants aged from 40 to 90+ years old. Forty responses were from autistic people aged between 40 and 70, and three responses were provided by autistic people aged over 90. The following topics were identified using content analysis of the open-text response data through individual and joint coding sessions between YC, CAJ, and GRS. Some responses were categorized into multiple content topics.

Content topic 1: All sensory domains have an impact.

Over one-third of the responding participants (19/53; 36%, from both groups) attributed their experience of SPDs to specific sensory domains (i.e., auditory/sound, visual, tactile/touch, temperature, smell, etc.). Almost all of these individuals specified that they experienced difficulties with auditory stimuli. "*Noise*" was cited as problematic by 11 participants, with participants stressing that noises can be "*utterly overwhelming"* to their senses (autistic man, late-40s). The non-autistic participants also noted that unwanted noise was problematic: "*[I] get quite irritable with noise*" (non-autistic man, late-70s). Six participants mentioned that these noises are mostly experienced in public environments that they have no control over, such as "*incessant blaring announcements and bleeps on trains*" (autistic man, late-40s) and "*noise in the park"* (non-autistic man, late-70s).

Sensitivities to other senses, such as temperature, visual, and tactile stimuli, were pointed out by four autistic participants: "*As I've aged, my sensitivities to sound, smells,*

touch, light seem to have become worse." (autistic woman, mid-60s) and *"I'm even less able to cope with temperature now"* (autistic woman, mid-50s).

Furthermore, 7/53 responses (13%) used negatively framed emotional phrases to describe their sensory experiences, e.g., "*[I] feel bombarded*" (autistic man, mid-60s), "*[I've] always found [my senses to be] intolerable*" (autistic woman, mid-50s), and "*I have a far shorter temper*" (non-autistic man, late-70s). One participant also noted how their SPDs result in physical responses, "*it makes me feel nauseous and as if I can't breathe*" (autistic woman, late-70s).

Content topic 2: How SPDs tolerances change with age.

Over half of the participants (28/53; 53%, from both groups) highlighted how their SPDs have changed with age. Many participants (21/28) noted that their SPDs were getting worse with age: "*[I'm becoming] more sensitive with age*" (autistic woman, mid-40s), "*I deal less well…than…when I was younger*" (non-autistic women, early-60s) or having "*less capacity to tolerate [my senses] … [I make less] of an effort compared to when I was younger*" (autistic woman, early-40s). Three autistic people reported that their sensitivity "*remain[s] high*" (autistic woman, mid-50s) and their senses have "*always been a problem*" (autistic woman, mid-40s).

However, four autistic participants noted that they had adapted to their sensory experiences with time/age, resulting in them being able to be managed more effectively, e.g., "*most … sensory reactions have been experienced over and over … [I've] developed mechanisms to limit the impact*" (autistic man, mid-40s).

Content topic 3: Developing a variety of coping strategies.

About one-third of participants (17/53; 32%, all from the autistic group) shared strategies that they used to cope with SPDs. Seven participants described "*avoiding*" unwanted sensory stimuli, with some noting that they often "*have the power to avoid … [and do so] as much as possible*" (autistic woman, mid-40s). A result of this was that some opted to "*stay at home*" (autistic man, mid-60s) to control their sensory environments better.

Another common coping strategy was the use of external devices, such as noise-canceling headphones, to help control their sensory experiences; four participants found this intervention a helpful tool to reduce the negative influence of noise.

Finally, six participants described that "*learning sensory triggers has been very important*" (autistic woman, mid-40s). For example, an autistic man (mid-50s) "*learn[ed] what fabrics and smells [he] can tolerate*" and an autistic woman (mid-50s) noted "*understanding [the triggers of her] sensory issues… have helped*".

Content topic 4: Differences in attribution of SPDs.

Responses indicated that autistic and non-autistic people had different explanations for how their SPDs have changed with age. The non-autistic participants attributed their SPDs to general aging, e.g., "*that's just me being old*" (non-autistic man, late-70s) or "*my hearing isn't what it used to be*" (non-autistic woman, early-80s), while more autistic people attributed their SPDs change to age-related changes in the ability to cope with SPDs, e.g., "*…maybe it isn't worse but I'm just less willing to tolerate it all*" (autistic woman, mid-60s), and "*[I] have less capacity to tolerate situations I don't like*" (autistic woman, early-40s).

Content topic 5: Wide-spread implications of SPDs.

Fourteen participants (26%, all from the autistic group) noted that there are consequences to managing their SPDs. First, SPDs are likely to influence their daily functions, for example: living skills ("*I'm not so skilled in survival techniques*", autistic woman, mid-40s), communication skills ("*found commuting particularly tough over recent years*", autistic man, mid-40s), resilience ("*My resilience to feeling 'battered and bruise[d]' by routine living has deteriorated", autistic man, early-60s*), and abilities to do other tasks ("*keeps me from doing things*", autistic woman, early-90s).

Additionally, while some coping strategies (e.g., avoiding stimuli by staying at home) help manage the problem, they can result in other problems, e.g., becoming isolated: "*[I'm] being shut away from the world*" (autistic man, mid-40s).

Furthermore, SPDs may be more difficult and effortful to manage with age, e.g. "*[it requires a] massive amount of energy [is] put in to manage this*" (autistic man, mid-60s) and "*it is effortful*" (autistic woman, early-90s), and that SPDs can have an increasing impact, e.g., "*it takes me days instead of hours to get over it*" (autistic woman, mid-40s).

Content topic 6: Receiving their autism diagnosis and improved self-awareness.

Eight autistic participants (15%) noted that their awareness of SPDs and how to manage them improved after their autism diagnosis. Before being diagnosed, one autistic woman (mid-40s) reported that she "*didn't know they were issues, [she] just assumed it was the same for everyone, or [that she] was just being fussy*". However, after receiving her autism diagnosis, "*[her understanding/awareness] changed so much*". This sentiment was echoed by other participants: "*My coping skills have improved greatly as I've had my diagnosis and support.*" (autistic woman, mid-40s), "*[I] didn't realise until awareness/diagnosis about my reactions to sensory problems.*" (autistic woman, mid-40s). Finally, even though sensory issues are still problematic for autistic people, an improved understanding of themselves through diagnosis and better awareness of SPDs allowed autistic people to "*manage/cope with a situation – mostly*" (autistic man, mid-60s) and "*know the signals and my limits*" (autistic man, mid-40s).

[Insert Table 4]

DISCUSSION

The current study investigates sensory processing differences (SPDs) and their relations with mental health symptoms in middle-aged and older autistic adults. Overall, SPDs and mental health symptoms were more apparent in autistic people aged 40 to 90+ years old, compared to a gender and age-matched non-autistic group, with autistic women showing higher levels of SPDs and anxiety/depression symptoms than autistic men. Regarding the cross-sectional age associations, SPDs and mental health symptoms were positively associated with age in the autistic group and negatively associated with age in the non-autistic group. The autistic participants reported being less able to cope with their SPDs; this was particularly common in the autistic participants who were older and who had more frequent SPDs and higher levels of anxiety and depression. Additionally, a positive association between the presence of SPDs and symptoms of anxiety and depression was observed in middle-aged and older autistic people, with the strength of associations between the frequency of SPDs and depression symptoms increasing with age. Combining quantitative and qualitative evidence, these findings suggest that autistic adults in midlife and older age may be more likely to have a heightened risk of SPDs and associated poorer mental health.

While SPDs continued to occur commonly throughout autistic midlife and older age, this study documents that these difficulties were found to be more commonly reported by autistic women. A similar gender difference in the level of SPDs was also found in studies of younger autistic individuals by Weiland et al[9] and Tavassoli et al[34]. Many autistic adults receive their autism diagnosis in adulthood,[35] however, health records suggest that many autistic women remain undiagnosed,[36] including in midlife and older age.[35,37] Therefore, Weiland et al[9] suggested that autistic women who receive an autism diagnosis (or who self-identify as autistic) may generally show more obvious or stereotyped characteristics than autistic men,[36] resulting in a relatively higher level of sensory symptoms observed among autistic women. Additionally, considering the targeted age range in the current study (i.e., age over 40 years), this gender difference could partially stem from menopause, which is associated with a host of physiological and mental health symptoms.[38-40] In the current study, several autistic women aged over 50 described their difficulties in regulating body temperature. In qualitative studies of menopause in autism by Moseley et al[38,41], several autistic women also noted menopausal hot flushes/flashes as being especially challenging for them. Therefore, menopausal changes may heighten the extent of SPDs and even generate new ones for autistic women with sensory difficulties.[38] This could magnify the gender differences in SPDs between middle-aged and older autistic men and women.

Although there is consistent and sufficient evidence for more apparent SPDs in autistic

people than non-autistic people over the lifespan, the existing literature has varied findings concerning how SPDs change with age in autistic populations. However, different conclusions may be partially related to variations in the design of sensory measurements and the age ranges examined in these studies,[12,14,16] and thus the current results are not directly comparable to previous findings. For the first time, the current study shows that, in addition to the existing substantial level of SPDs in middle adulthood, there may be a further increase in SPDs from midlife to older age in autistic people.

In contrast to this positive age association with SPDs in the autistic group, among our gender and age-matched non-autistic group, lower levels of SPDs were observed in older versus younger midlife adults. In previous aging research in the general population, Pohl et al[42] found that older people (>80 years old) noticed less sensory input and were less likely to seek sensory experiences than those who were younger than 70 years old. Similar sensory changes were described by several current non-autistic participants in open-text responses. When associations between age and SPDs in autistic and non-autistic groups are taken together, they point toward a possibility that autistic adults experience old age differently from non-autistic adults. However, further longitudinal work is needed to understand how SPDs and aging interact.

Another plausible influencing factor for these diverse associations between age and SPDs in the autistic and non-autistic groups may be differences in their abilities to cope with SPDs during adulthood. In general, the current study documents that older autistic people are more likely to report their sensory coping skills as getting worse with age, while most non-autistic people noted a better or similar level of coping ability during adulthood, with no significant age differences being observed. It has been suggested that improvements in SPDs observed in young and middle-aged autistic people may be related to them continuously learning new coping strategies, enabling them to manage their sensory experiences over time.[7,10,12,16] Therefore, it is possible that autistic people whose coping ability had got worse over adulthood may have higher risks of experiencing SPDs especially when reaching older age, while non-autistic adults may be protected by their effective coping skills, even in later adulthood. This idea highlights the importance for autistic people to be supported with developing their coping skills, which may mitigate the risk of heightened SPDs later in life. As noted by autistic participants in MacLennan et al[10] and in the current study, receiving support and listening to suggestions from professionals and other autistic people could be a source for self-understanding of their sensory experiences and help improve their abilities to manage undesired sensory experiences. However, communication

difficulties and sensory challenges in medical settings may be barriers for some autistic people to meet their support needs,[11,43,44] signaling the necessity of facilitating access to healthcare and services for autistic adults.[37,44,45] In addition to making public places more sensory enabling for autistic individuals,[11] future researchers and designers could consider other possible improvements in sensory equipment, such as developing noise-canceling headphones with tuneable targeting loudness and frequency, to meet a wider range of individual sensory needs.

Poorer mental health is one of the negative consequences associated with SPDs in autistic populations. In the current study, autistic adults with more SPDs generally reported higher levels of anxiety and depression symptoms, replicating previous findings with autistic people in other age ranges.[14,21] Furthermore, the association between SPDs and depression was found to a greater extent in older autistic people. Given this close correlation between sensory and mental health symptoms in autistic populations across the lifespan, targeted interventions are needed to reduce the heightened risks of SPDs and mental health symptoms, especially for older autistic people. However, it should be noted that mental health conditions in autistic adults were found to be related to a variety of factors, including the use of disengagement coping strategies,[46] autism acceptance,[47] social support,[48] etc. Therefore, whether sensory interventions have any direct positive effects on autistic mental health is yet to be determined.[49-51] As there is a lack of research focusing on sensory interventions with autistic adults, especially with midlife or older autistic populations, this will be an important research topic for future studies.

Limitations and future directions

When contextualizing the findings of the current study, it is important to note some limitations. First, when considering the study design, our findings are based on self-report measures and are cross-sectional in nature. As such, we are unable to infer predictive relationships from these findings. Additionally, we used a brief set of validated (i.e., the 3-item sensory reactivity subdomain of the RAADS-14) and bespoke questions to examine SPDs. Future autism research should further explore SPDs using comprehensive standardized sensory measures that account for different subtypes of sensory differences (e.g., hypersensitivity, hyposensitivity, sensation seeking, etc.). Furthermore, dedicated qualitative and quantitative studies with a focus on the examination of sensory differences in midlife and older age are needed for a deeper understanding of autistic peoples' experiences as they age.

Second, when considering our participant sample, while our quantitative analyses were well-powered, only 53 of the 432 participants provided open-text responses to

contextualize their lived experiences. Also, despite having no geographic restrictions on participation, most participants were from the UK (likely due to recruitment methods). Therefore, we are unable to generalize these qualitative findings to a wider population. Another consideration is while our sample was balanced in men/male and women/female proportions, very few non-binary/trans/genderfluid individuals took part in this study. Given the well-evidenced gender diversity in autistic populations,[52] future studies should seek to recruit gender-diverse populations to understand sensory differences across autistic gender groups.

Finally, when considering the age of autism diagnosis in this current sample, most of our participants were diagnosed/self-identified as autistic in adulthood (mean=10 years since diagnosis/self-identification). Age of diagnosis/self-identification could play an important role in putting support mechanisms in place to mitigate the risks of SPDs and the possible impacts on poorer mental health. Other factors, such as physical health and living situations (e.g., with family members or alone), may also link with SPDs and mental health in older autistic adults. As such, future research should explore SPDs longitudinally to examine how SPDs interact with various experiences and developmental outcomes across autistic people's lifespans.

Conclusion

This is the first study to specifically focus on sensory processing differences (SPDs) in middle-aged and older autistic adults. Overall, levels of SPDs and anxiety/depression symptoms in autistic people increased across their lifespans in our cross-sectional analyses. Autistic adults with higher levels of SPDs were also at heightened risk of poorer mental health later in life. Combining quantitative and qualitative evidence, this study extends our previous understanding of SPDs beyond predominantly younger autistic populations. Additionally, our findings highlight the necessity to explore sensory difficulties in autistic adults across the lifespan, with a focus on midlife and older age.

AUTHOR CONTRIBUTIONS

Authors YC, GRS and WM conceived the current study. Authors GRS, RAC and FH conceived the AgeWellAutism project. GRS designed the online survey and selected materials. YC, CAJ and GRS conducted the analyses, with support from WM. YC wrote the manuscript under the supervision of GRS and WM, with CAJ, RAC, and FH reviewing and editing drafts. All authors have read and approved the final manuscript.

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CONFLICTS OF INTEREST

None to declare.

REFERENCES

1. Tomchek SD, Dunn W. Sensory processing in children with and without autism: a comparative study using the short sensory profile. *Am J Occup Ther*. 2007;61(2):190-200. doi:10.5014/ajot.61.2.190

2. Asperger H, Frith UT. 'Autistic psychopathy'in childhood (U. Frith, Trans.). In: Frith U, ed. *Autism and Asperger syndrome*. (This chapter is an annotated translation of a German article by Hans Asperger that was published in "Archiv für Psychiatrie und Nervenkrankenheiten," 1944, 117, 76-136. The original also appeared in "Heilpädagogik," Vienna: Springer-Verlag, 1952). Cambridge University Press; 1991:37–92.

3. Dawson G, Watling R. Interventions to facilitate auditory, visual, and motor integration in autism: A review of the evidence. *J Autism Dev Disord*. 2000;30(5):415-421. doi:10.1023/A:1005547422749

4. Marco EJ, Hinkley LB, Hill SS, Nagarajan SS. Sensory processing in autism: a review of neurophysiologic findings. *Pediatr Res*. 2011;69:48-54. doi:10.1203/PDR.0b013e3182130c54

5. Tavassoli T, Bellesheim K, Tommerdahl M, Holden JM, Kolevzon A, Buxbaum JD. Altered tactile processing in children with autism spectrum disorder. *Autism Res*. 2016;9(6):616-620. doi:10.1002/aur.1563

6. Tavassoli T, Miller LJ, Schoen SA, Brout JJ, Sullivan J, Baron-Cohen S. Sensory reactivity, empathizing and systemizing in autism spectrum conditions and sensory processing disorder. *Dev Cogn Neurosci*. 2018;29:72-77.

doi:10.1016/j.dcn.2017.05.005

7. Hazen EP, Stornelli JL, O'Rourke JA, Koesterer K, McDougle CJ. Sensory symptoms in autism spectrum disorders. *Harv Rev Psychiatry*. 2014;22(2):112-124. doi:10.1097/01.HRP.0000445143.08773.58

8. Billstedt E, Carina Gillberg I, Gillberg C. Autism in adults: symptom patterns and early childhood predictors. Use of the DISCO in a community sample followed from childhood. *J Child Psychol Psychiatry*. 2007;48(11):1102-1110. doi:10.1111/j.1469-7610.2007.01774.x

9. Weiland RF, Polderman TJ, Hoekstra RA, Smit DJ, Begeer S. The Dutch Sensory Perception Quotient-Short in adults with and without autism. *Autism*. 2020;24(8):2071-2080. doi:10.1177/1362361320942085

10. MacLennan K, O'Brien S, Tavassoli T. In our own words: The complex sensory experiences of autistic adults. *J Autism Dev Disord*. 2022;52(7):3061-3075. doi:10.1007/s10803-021-05186-3

11. MacLennan K, Woolley C, @ 21andsensory E, et al. "It is a big spider web of things": Sensory experiences of autistic adults in public spaces. *Autism Adulthood*. 2023;5(4):411-422. doi:10.1089/aut.2022.0024

12. Kern JK, Trivedi MH, Garver CR, et al. The pattern of sensory processing abnormalities in autism. *Autism*. 2006;10(5):480-494. doi:10.1177/1362361306066564

13. Kern JK, Trivedi MH, Grannemann BD, et al. Sensory correlations in autism. *Autism*. 2007;11(2):123-134. doi:10.1177/1362361307075702

14. Hwang YI, Arnold S, Srasuebkul P, Trollor J. Understanding anxiety in adults on the autism spectrum: An investigation of its relationship with intolerance of uncertainty, sensory sensitivities and repetitive behaviours. *Autism*. Feb 2020;24(2):411-422. doi:10.1177/1362361319868907

15. Leekam SR, Nieto C, Libby SJ, Wing L, Gould J. Describing the sensory abnormalities of children and adults with autism. *J Autism Dev Disord*. 2007;37(5):894-910. doi:10.1007/s10803-006-0218-7

16. Crane L, Goddard L, Pring L. Sensory processing in adults with autism spectrum disorders. *Autism*. 2009;13(3):215-228. doi:10.1177/1362361309103794

17. Mason D, Stewart GR, Capp SJ, Happé F. Older age autism research: A rapidly growing field, but still a long way to go. *Autism Adulthood*. 2022;4(2):164-172. doi:10.1089/aut.2021.0041

18. Lever AG, Geurts HM. Psychiatric co-occurring symptoms and disorders in young, middle-aged, and older adults with autism spectrum disorder. *J Autism Dev Disord*. 2016;46(6):1916-1930. doi:10.1007/s10803-016-2722-8

19. Stewart GR, Corbett A, Ballard C, et al. The mental and physical health profiles of older adults who endorse elevated autistic traits. *J Gerontol B Psychol Sci Soc Sci*. 2021;76(9):1726-1737. doi:10.1093/geronb/gbaa112

20. Syu Y-C, Lin L-Y. Sensory overresponsivity, loneliness, and anxiety in Taiwanese adults with autism spectrum disorder. *Occup Ther Int*. 2018;20189165978. doi:10.1155/2018/9165978

21. Verhulst I, MacLennan K, Haffey A, Tavassoli T. The perceived causal relations

between sensory reactivity differences and anxiety symptoms in autistic adults. *Autism Adulthood*. 2022;4(3):183-192. doi:10.1089/aut.2022.0018

22. Robertson AE, Simmons DR. The sensory experiences of adults with autism spectrum disorder: A qualitative analysis. *Perception*. 2015;44(5):569-586. doi:10.1068/p7833

23. Parmar KR, Porter CS, Dickinson CM, Pelham J, Baimbridge P, Gowen E. Visual sensory experiences from the viewpoint of autistic adults. *Front Psychol*. 2021;12633037. doi:10.3389/fpsyg.2021.633037

24. Green SA, Ben-Sasson A, Soto TW, Carter AS. Anxiety and sensory over-responsivity in toddlers with autism spectrum disorders: Bidirectional effects across time. *J Autism Dev Disord*. Jun 2012;42(6):1112-1119. doi:10.1007/s10803-011-1361-3

25. Pfeiffer B, Kinnealey M, Reed C, Herzberg G. Sensory Modulation and Affective Disorders in Children and Adolescents With Asperger's Disorder. *Am J Occup Ther*. May-Jun 2005;59(3):335-345. doi:10.5014/ajot.59.3.335

26. Chen Y, Hantman RM, Tager-Flusberg H. Parent-rated anxiety in autistic adolescents and young adults: Concurrent links to autism traits and chronic sleep problems. *Res Autism Spectr Disord*. March 2023;101 102104. doi:10.1016/j.rasd.2023.102104

27. Eriksson JM, Andersen LM, Bejerot S. RAADS-14 Screen: validity of a screening tool for autism spectrum disorder in an adult psychiatric population. *Mol Autism*. 2013;4(1)49. doi:10.1186/2040-2392-4-49

28. Spitzer RL, Kroenke K, Williams JB, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med*. 2006;166(10):1092-1097. doi:10.1001/archinte.166.10.1092

29. Kroenke K, Spitzer RL, Williams JB. The PHQ‐9: validity of a brief depression severity measure. *J Gen Intern Med*. 2001;16(9):606-613. doi:10.1046/j.1525-1497.2001.016009606.x

30. Arnold SR, Uljarević M, Hwang YI, Richdale AL, Trollor JN, Lawson LP. Brief report: psychometric properties of the patient health Questionaire-9 (PHQ-9) in autistic adults. *J Autism Dev Disord*. 2020;50:2217-2225. doi:10.1007/s10803-019-03947-9

31. *IBM SPSS Statistics for Macintosh, Version 29.0.* Armonk, NY: IBM Corp; 2022.

32. Elo S, Kyngäs H. The qualitative content analysis process. *J Adv Nurs*. 2008;62(1):107-115. doi:10.1111/j.1365-2648.2007.04569.x

33. Krippendorff K. *Content analysis: An introduction to its methodology*. Sage publications; 2018.

34. Tavassoli T, Hoekstra RA, Baron-Cohen S. The Sensory Perception Quotient (SPQ): development and validation of a new sensory questionnaire for adults with and without autism. *Mol Autism*. 2014;5(29):10. doi:10.1186/2040-2392-5-29

35. Pellicano E, Fatima U, Hall G, et al. A capabilities approach to understanding and supporting autistic adulthood. *Nat Rev Psychol*. 2022;1(11):624-639. doi:10.1038/s44159-022-00099-z

36. Evans SC, Boan AD, Bradley C, Carpenter LA. Sex/gender differences in

screening for autism spectrum disorder: Implications for evidence-based assessment. *J Clin Child Adolesc Psychol*. 2018;48(6):840–854. doi:10.1080/15374416.2018.1437734

37. O'Nions E, Petersen I, Buckman JE, et al. Autism in England: assessing underdiagnosis in a population-based cohort study of prospectively collected primary care data. *Lancet Reg Health Eur*. 2023;29100626. doi:10.1016/j.lanepe.2023.100626

38. Moseley RL, Druce T, Turner-Cobb JM. 'When my autism broke': A qualitative study spotlighting autistic voices on menopause. *Autism*. 2020;24(6):1423-1437. doi:10.1177/1362361319901184

39. Newhart MR. Menopause matters: The implications of menopause research for studies of midlife health. *Health Sociol Rev*. 2013;22(4):365-376. doi:10.5172/hesr.2013.22.4.365

40. Groenman AP, Torenvliet C, Radhoe TA, Agelink van Rentergem JA, Geurts HM. Menstruation and menopause in autistic adults: Periods of importance? *Autism*. 2022;26(6):1563-1572.

41. Moseley RL, Druce T, Turner‐Cobb JM. Autism research is 'all about the blokes and the kids': Autistic women breaking the silence on menopause. *Br J Health Psychol*. 2021;26(3):709-726. doi:10.1111/bjhp.12477

42. Pohl PS, Dunn W, Brown C. The Role of Sensory Processing in the Everyday Lives of Older Adults: Occupation, Participation and Health. *OTJR (Thorofare N J)*. Jul 2003 2003;23(3):99-106. doi:10.1177/153944920302300303

43. Wise EA. Aging in autism spectrum disorder. *Am J Geriatr Psychiatry*. 2020;28(3):339-349. doi:10.1016/j.jagp.2019.12.001

44. Doherty M, McCowan S, Shaw SC. Autistic SPACE: a novel framework for meeting the needs of autistic people in healthcare settings. *Br J Hosp Med*. 2023;84(4):1-9. doi:10.12968/hmed.2023.0006

45. Nicolaidis C, Raymaker D, McDonald K, et al. Comparison of healthcare experiences in autistic and non-autistic adults: a cross-sectional online survey facilitated by an academic-community partnership. *J Gen Intern Med*. 2013;28:761-769. doi:10.1007/s11606-012-2262-7

46. Muniandy M, Richdale AL, Arnold SR, Trollor JN, Lawson LP. Associations between coping strategies and mental health outcomes in autistic adults. *Autism Res*. 2022;15(5):929-944. doi:10.1002/aur.2694

47. Cage E, Di Monaco J, Newell V. Experiences of autism acceptance and mental health in autistic adults. *J Autism Dev Disord*. 2018;48:473-484. doi:10.1007/s10803-017-3342-7

48. Charlton RA, McQuaid GA, Wallace GL. Social support and links to quality of life among middle-aged and older autistic adults. *Autism*. 2023;27(1):92-104. doi:10.1177/13623613221081917

49. Moseley RL, Gregory NJ, Smith P, Allison C, Baron-Cohen S. A 'choice', an 'addiction', a way 'out of the lost': exploring self-injury in autistic people without intellectual disability. *Mol Autism*. 2019;10(1)18. doi:10.1186/s13229-019-0267-3

50. Edgington L, Hill V, Pellicano E. The design and implementation of a CBT-based

intervention for sensory processing difficulties in adolescents on the autism spectrum. *Res Dev Disabil*. 2016;59:221-233. doi:10.1016/j.ridd.2016.09.004

51. Lang R, O'Reilly M, Healy O, et al. Sensory integration therapy for autism spectrum disorders: A systematic review. *Res Autism Spectr Disord*. 2012;6(3):1004-1018. doi:10.1016/j.rasd.2012.01.006

52. Kallitsounaki A, Williams DM. Autism spectrum disorder and gender dysphoria/incongruence. A systematic literature review and meta-analysis. *J Autism Dev Disord*. 2023;53(8):3103-3117. doi:10.1007/s10803-022-05517-y

Table 1.

Demographic characteristics and group differences by neurotype groups.

		Autistic (*n*=265)		Non-autistic (*n*=167)		Group difference
Gender	Men	124	46.79%	84	50.30%	$X^2(2)=2.86$, $p=.239$, $v=.08$
	Women	137	51.70%	83	49.70%	
	Non-binary/Genderfluid	4	1.51%	0	0.00%	
Age	*M* (*SD*) in years	60.59 (12.89)		60.53 (13.54)		$t(430)=-0.05$, $p=.960$, $d=13.15$
	Range	40 - 91		40 - 93		
Co-occurring mental health conditions	Depression	158	59.62%	34	20.36%	$X^2(1)=63.96$, **$p<.001$**, $v=.39$
	Anxiety	167	63.02%	24	14.37%	$X^2(1)=98.29$, **$p<.001$**, $v=.48$
	Panic attack	84	31.70%	9	5.39%	$X^2(1)=41.97$, **$p<.001$**, $v=.31$
	OCD	39	14.70%	1	0.60%	$X^2(1)=24.30$, **$p<.001$**, $v=.24$
	Anorexia nervosa	50	18.87%	3	1.80%	$X^2(1)=27.74$, **$p<.001$**, $v=.25$
	Psychological binge eating	80	30.19%	19	11.38%	$X^2(1)=20.52$, **$p<.001$**, $v=.22$
	Personality disorder	73	27.55%	5	2.99%	$X^2(1)=41.74$, **$p<.001$**, $v=.31$
	ADHD/ADD	61	23.02%	1	0.60%	$X^2(1)=41.89$, **$p<.001$**, $v=.31$
	Other mental/psychiatric health conditions	21	7.92%	33	19.76%	$X^2(1)=13.12$, **$p<.001$**, $v=.17$
Employment status	Employed	75	28.30%	88	52.69%	$X^2(2)=45.65$, **$p<.001$**, $v=.33$
	Unemployed	65	24.53%	5	2.99%	
	Retired	125	47.17%	74	44.31%	
Education history	High school or below	167	63.02%	97	58.08%	$X^2(1)=1.05$, $p=.306$, $v=.05$
	Undergrad or above	98	36.98%	70	41.92%	

Note. Significant p-values are shown in bold.

Table 2.

Descriptive statistics and age correlations of Sensory Processing Differences (SPDs) and mental health scores by neurotype groups.

Measures		Autistic group (*n*=265)	non-Autistic group (*n*=167)	Group difference	Effect Size	Correlation with Age		Moderating effect of neurotype
Presence of SPDs	*M* (*SD*)	7.12 (1.96)	0.14 (0.64)	*t*(345.48)*=-53.47, ***p*<.001**	*d*=-4.30 [-4.74, -4.04]	Autistic: *r*=.44, ***p*<.001**	non-Autistic: *r*=-.22, ***p*=.004**	*b*=.08, ***p*<.001**, R^2change=.02
Freq. of overwhelming SPDs	*M* (*SD*)	3.60 (1.10)	2.19 (1.18)	*t*(430)=-12.67, ***p*<.001**	*d*=-1.25 [-1.46, -1.04]	Autistic: *r*=.28, ***p*<.001**	non-Autistic: *r*=-.11, *p*=.153	*b*=.03, ***p*<.001**, R^2change=.03
Change in coping ability for SPDs	better : same : worse *n*, (%)	36 : 113 : 115 (13.6%:42.8%:43.6%)	52 : 99 : 16 (31.1%:59.3%:9.6%)	X^2(2)=66.19, ***p*<.001**	*v*=.37		-	
Anxiety symptoms	*M* (*SD*)	6.36 (3.37)	2.49 (1.61)	*t*(404.89)*=-16.05, ***p*<.001**	*d*=-1.37 [-1.59, -1.16]	Autistic: *r*=-.19, ***p*=.003**	non-Autistic: *r*=-.19, ***p*=.013**	*b*=.07, ***p*<.001**, R^2change=.02
	n above cut-off (≥10)	*n*=33 (12.5%)	*n*=0 (0.0%)	X^2(1)=22.52, ***p*<.001**	*v*=.23		-	
Depression symptoms	*M* (*SD*)	9.82 (5.39)	2.99 (2.40)	*t*(393.79)*=-17.96, ***p*<.001**	*d*=-1.52 [-1.74, -1.30]	Autistic: *r*=.43, ***p*<.001**	non-Autistic: *r* =-.26, ***p*<.001**	*b*=.22, ***p*<.001**, R^2change=.07
	n above cut-off (≥10)	*n*=150 (56.6%)	*n*=3 (1.8%)	X^2(1)=134.53, ***p*<.001**	*v*=.56		-	

Note. Effect size calculated using Cohen's *d* or Cramer's *v*. Significant *p*-values are shown in bold.

*Levene's test is significant, indicating that the group variances are unequal. Welch t-test is used.

Table 3.

Associations between Sensory Processing Differences (SPDs) and mental health scores by neurotype groups.

	Presence of SPDs	Freq. of overwhelming SPDs	Anxiety symptoms	Depression symptoms
Presence of SPDs	-	*r*=.47, ***p*<.001**	*r*=.47, ***p*<.001**	*r*=.66, ***p*<.001**
Freq. of overwhelming SPDs	*r*=.21, ***p*=.006**	-	*r*=.32, ***p*<.001**	*r*=.32, ***p*<.001**
Anxiety symptoms	*r*=.08, *p*=.281	*r*=.14, *p*=.081	-	*r*=.73, ***p*<.001**
Depression symptoms	*r*=.19, ***p*=.015**	*r*=.14, *p*=.068	*r*=.62, ***p*<.001**	-

Note. Significant p-values are shown in bold. Above diagonal, associations in the autistic group and below diagonal, associations in the non-autistic group.

Table 4.

Content topics and example quotes for contextualisation of the lived experience of Sensory Processing Differences (SPDs).

Content topics	Example quotes
Topic 1: All sensory domains have an impact.	"*Certain environments (some shops) and noises (hand dryers) can be utterly overwhelming. As I get older I prefer silence.*" (autistic man in 40s) "*Can't pick out conversation with background noise. Need sunshine, music, colours. Can't bear artificial light 1st thing in morning. Need even temperature (whole body) in bed. Some textures irritate.*" (autistic woman in 50s) "*Noise, heat, pins and needles, aches and pains from getting older...*" (autistic woman in 80s) "*Very hard to manage noise*" (autistic woman in 90s) "*Far more irritable with school noise*" (non-autistic woman in 40s) "*I have a far shorter temper so more bothered by noisy places*" (non-autistic man in 70s)
Topic 2: How SPDs tolerances change with age.	"*Being over 40 helps as most of the "surprises" in bizarre sensory reactions have been experienced over and over and I have developed mechanisms to limit the impact.*" (autistic man in 40s) "*So much more sensitive with age*" (autistic woman in 40s) "*…it's become worse as I've aged*" (non-binary autistic in 40s) "*Learning what fabrics and smells I can tolerate have been game changers for me*" (autistic man in 50s) "*…even less able to cope with temperature and sound now.*" (autistic woman in 50s) "*… always found this intolerable and still do*" (autistic woman in 50s) "*The sensitivity is far worse now than when I was younger*." (autistic man in 70s) "*I have been able to improve the sensitivity but it is effortful.*" (autistic woman in 90s) "*My hearing isn't what it used to be*" (non-autistic woman in 80s)
Topic 3: Developing a variety of coping strategies.	"*I think I'm less tolerant but more able to avoid. As I child you have to survive in situations you are [forced] to be in like school and parties. As an adult I have the power to avoid those situations as much as possible.*" (autistic woman in 40s) "*Only because of technology changes, like noise cancelling headphones*" (autistic man in 50s) "*Understanding of sensory issues and noise cancelling headphones have helped.*" (autistic woman in 50s)

Table 4. (*continued*)

Content topics	Example quotes
Topic 3: Developing a variety of coping strategies (cont.).	"*Noise cancelling headphones and learning what fabrics and smells I can tolerate have been game changers for me.*" (autistic man in 50s) "*I stay at home a lot because of it.*" (autistic man in 60s) "*I stay in so it has got better but if I were to go out I know I wouldn't cope very well.*" (autistic woman in 60s)
Topic 4: Differences in attribution of SPDs.	"*Have less capacity to tolerate situations I don't like- made more of an effort when I was younger*" (autistic woman in 40s) "*Just occurred to me that maybe it isn't worse but I'm just less willing to tolerate it all*" (autistic woman in 60s) "*I get quite irritable with noise in the park, but that's just me being old!*" (non-autistic man in 70s)
Topic 5: Wide-spread implications of SPDs.	"*As an adult I have the power to avoid those situations as much as possible. This is better for my mental health but also means that I'm not so skilled in survival techniques so if I do end up in a tricky situations I'm less practised to tune out the elime T's I find difficult so I'm more likely to flee.*" (autistic woman in 40s) "*Being shut away from the world*" (autistic man in 40s) "*I also cannot listen to people talking for too long. that means I cannot listen and respond to others for long - it makes me feel nauseous and as if I can't breathe.*" (autistic woman in 50s) "*Even the smallest disturbance will make me shut down*" (autistic man in 70s) "*I try to contain the problem but that just makes other problems worse*" (autistic man in 90s)
Topic 6: Receiving their autism diagnosis and improved self-awareness.	"*I can't get rid of sensory issues but I know the signals and my limits.*" (autistic man in 40s) *"My sensitivity to sensory issues became heightened during a very stressful period which led to autism diagnosis - sensitivity has remained high ever since*." (Autistic woman in 50s) "*Diagnosed late in life, so I'm aware of what is happening so am able to manage/cope with a situation – mostly*" (autistic man in 60s).

Supplementary Table 1.

Descriptive statistics and gender differences of Sensory Processing Differences (SPDs) and mental health scores by neurotype and gender groups.

Measures	Sample groups	*M* (*SD*)	Main effect		Interaction	Gender difference within neurotype	
			Neurotype	Gender		*t*-test results	Effect size
Presence of SPDs	Autistic Men	6.71 (2.05)	*F*(1,424)=2025.99, ***p*<.001**	*F*(1,424)=10.91, ***p*=.001**	*F*(1,424)=3.03, *p*=.082	*t*(259)=-3.26, ***p*=.001**	*d*=-0.40 [-0.65, -0.16]
	Autistic Women	7.49 (1.82)					
	Non-autistic Men	0.02 (0.22)				*t*(92.14)=-2.45, ***p*=.016**	*d*=-0.38 [-0.69, -0.07]
	Non-autistic Women	0.27 (0.87)					
Freq. of overwhelming SPDs	Autistic Men	3.31 (1.11)	*F*(1,424)=158.73, ***p*<.001**	*F*(1,424)=7.57, ***p*=.006**	*F*(1,424)=4.32, ***p*=.038**	*t*(259)=-4.03, ***p*<.001**	*d*=-0.50 [-0.75, -0.25]
	Autistic Women	3.85 (1.03)					
	Non-autistic Men	2.15 (1.20)				*t*(164.95)=-0.41, *p*=.685	*d*=-0.06 [-0.37, 0.24]
	Non-autistic Women	2.23 (1.16)					
Anxiety symptoms	Autistic Men	6.33 (3.36)	*F*(1,424)=192.78, ***p*<.001**	*F*(1,424)=0.12, *p*=.735	*F*(1,424)=0.06, *p*=.809	/‡	/‡
	Autistic Women	6.36 (3.34)					
	Non-autistic Men	2.40 (1.56)					
	Non-autistic Women	2.57 (1.65)					
Depression symptoms	Autistic Men	9.57 (5.23)	*F*(1,424)=237.61, ***p*<.001**	*F*(1,424)=0.73, *p*=.394	*F*(1,424)=0.05, *p*=.818	/‡	/‡
	Autistic Women	10.05 (5.50)					
	Non-autistic Men	2.86 (2.29)					
	Non-autistic Women	3.13 (2.51)					

Note. Significant *p*-values are shown in bold. Effect size calculated using Cohen's *d*. Autistic men *n*=124, autistic women *n*=137, non-autistic men *n*=84, non-autistic women *n*=83.

‡ The main effect of gender was not significant.

Supplementary Table 2.

Correlations by neurotype and gender groups between age and Sensory Processing Differences (SPDs) and mental health scores; and the moderating effect of gender on the strength of correlations.

Measures	Sample group	*r*	*p*	Moderating effect of gender
Presence of SPDs	Autistic Men	.56	**<.001**	*b*=.04, ***p*=.016**, R^2change=.02
	Autistic Women	.31	**<.001**	
	Non-autistic Men	-.16	.137	*b*=.02, ***p*=.016**, R^2change=.03
	Non-autistic Women	-.29	**.009**	
Freq. of overwhelming SPDs	Autistic Men	.38	**<.001**	*b*=.02, *p*=.090, R^2change=.01
	Autistic Women	.18	**0.040**	
	Non-autistic Men	-.03	0.764	*b*=.02, *p*=.251, R^2change=.01
	Non-autistic Women	-.20	0.069	
Anxiety symptoms	Autistic Men	.16	0.085	*b*=-.02, *p*=.530, R^2change=.002
	Autistic Women	.22	**0.010**	
	Non-autistic Men	-.26	**0.017**	*b*=-.01, *p*=.485, R^2change=.003
	Non-autistic Women	-.12	0.295	
Depression symptoms	Autistic Men	.44	**<.001**	*b*=-.01, *p*=.824, R^2change<.001
	Autistic Women	.41	**<.001**	
	Non-autistic Men	-.26	**0.018**	*b*=-.01, *p*=.666, R^2change=.001
	Non-autistic Women	-.27	**0.016**	

Note. Significant *p*-values are shown in bold. Autistic men *n*=124, autistic women *n*=137, non-autistic men *n*=84, non-autistic women *n*=83.

Supplementary Table 3.

Descriptive statistics of the change of ability to cope with Sensory Processing Differences (SPDs) by neurotype and gender groups.

	n (%)				Age *M* (*SD*)	
	Autistic (*n*=264‡)		Non-autistic (*n*=167)		Autistic	Non-autistic
	Men (%)	Women (%)	Men (%)	Women (%)		
Better	22 (17.7%[1])	14 (10.3%[1])	28 (33.3%)	24 (28.9%)	53.67 (12.21)	58.90 (11.68)
Same	51 (41.1%)	62 (45.6%)	48 (57.1%)	51 (61.4%)	58.51 (11.17)	61.13 (13.40)
Worse	51 (41.1%)	60 (44.1%)	8 (9.5%)	8 (9.6%)	64.85 (13.36)	62.06 (19.43)

‡One autistic participant did not respond to this Bespoke question.

[1] Percentage of autistic men/women who report their coping ability as getting better.

Supplementary Table 4.

Descriptive statistics of Sensory Processing Differences (SPDs) and mental health scores by neurotype groups for the *change of ability to cope with SPDs.*

	Freq. of overwhelming SPDs *M* (*SD*)		Anxiety symptoms *M* (*SD*)		Depression symptoms *M* (*SD*)	
	Autistic	Non-autistic	Autistic	Non-autistic	Autistic	Non-autistic
Better	3.33 (1.07)	2.23 (1.23)	5.19 (3.45)	2.46 (1.13)	7.86 (5.54)	2.38 (1.12)
Same	3.36 (1.07)	2.13 (1.16)	6.28 (3.19)	2.40 (1.65)	8.73 (4.78)	2.98 (2.56)
Worse	3.92 (1.06)	2.44 (1.15)	6.84 (3.42)	3.06 (2.46)	11.56 (5.38)	5.06 (3.26)

Note. Autistic group *n*=264, non-autistic group *n*=167.

Supplementary Table 5.

Associations between Sensory Processing Differences (SPDs) and mental health scores by neurotype and gender groups.

		Presence of SPDs	Freq. of overwhelming SPDs	Anxiety symptoms	Depression symptoms
Presence of SPDs	Men	-	*r*=.56, ***p*<.001**	*r*=.45, ***p*<.001**	*r*=.69, ***p*<.001**
	Women	-	*r*=.32, ***p*<.001**	*r*=.48, ***p*<.001**	*r*=.63, ***p*<.001**
Freq. of overwhelming SPDs	Men	*r*=-.01, *p*=.897	-	*r*=.30, ***p*<.001**	*r*=.37, ***p*<.001**
	Women	***r*=.31, *p*=.004**	-	*r*=.33, ***p*<.001**	*r*=.27, ***p*=.001**
Anxiety symptoms	Men	***r*=.33, *p*=.003**	***r*=.22, *p*=.047**	-	*r*=.73, ***p*<.001**
	Women	*r*=.03, *p*=.788	*r*=.05, *p*=.639	-	*r*=.72, ***p*<.001**
Depression symptoms	Men	*r*=.15, *p*=.168	*r*=.13, *p*=.250	***r*=.59, *p*<.001**	-
	Women	***r*=.22, *p*=.047**	*r*=.15, *p*=.168	***r*=.65, *p*<.001**	-

Note. Significant *p*-values are shown in bold. Above diagonal, associations in the autistic group and below diagonal, associations in the non-autistic group.

Supplementary Figure 1. Interaction plot for frequency of overwhelming Sensory Processing Differences (SPDs). Error bars represent the standard deviation of overwhelming SPDs frequency in each neurotype/gender group.