

Neuropsychological

Trends

39

April 2026

- Elisa De Bartolo - Giovanni Cicinelli - Stefania Brighenti
Emanuela Nobile - Francesca Capiotto - Roberto Keller*
A pilot investigation of the Italian short version of the Sensory
Perception Quotient (SPQ) in autistic and neurotypical adults 7
- Davide Crivelli - Michela Balconi*
Neuroassessment and monitoring of higher cognitive functions
in naturalistic context: a case of organizational neuroscience 23
- Rael H. Morley - Paul B. Jantz - Anastasia J. Gumatay
Bayley R. Grimshaw*
The impact of posterior cingulate and dorsal lateral connectivity
on aggression 43
- Michela Balconi - Laura Angioletti - Angelica Daffinà*
Are you sure about your choice? EEG correlates of decision
confidence before and after reframing 63
- Domenico Gambino*
Are negative affect and executive functioning related in healthy
young adults? 87
-

A pilot investigation of the Italian short version of the Sensory Perception Quotient (SPQ) in autistic and neurotypical adults

Elisa De Bartolo¹ - Giovanni Cicinelli¹ - Stefania Brighenti¹ - Emanuela Nobile¹ - Francesca Capiotto^{1,2} - Roberto Keller^{1,2}

¹ Adult Autism Center, Mental Health Department, Local Health Unit ASL, Turin, Italy

² Department of Psychology, University of Turin, Turin, Italy

DOI: <https://doi.org/10.7358/neur-2026-039-deba>

francesca.capiotto@aslcitytorino.it

ABSTRACT

This study explored sensory processing differences between Italian autistic and neurotypical adults using the short-form Sensory Perception Quotient (SPQ). The primary aim was to conduct a preliminary evaluation of the Italian adaptation, examining feasibility and initial psychometric properties to guide future validation. A total of 156 participants (79 autistic, 77 neurotypical) completed the SPQ, which assesses sensory sensitivity across taste, smell, vision, hearing, and touch. Analyses included internal consistency, item–total correlations, exploratory factor analysis, and correlations with demographic variables. Group differences were tested using ANOVA, General Linear Models controlling for age, sex, and education, and MANCOVA to reduce multiple comparison bias. Autistic participants reported significantly lower total SPQ scores, particularly in vision, hearing, and touch, indicating heightened sensory sensitivity. Age showed a modest association with reduced olfactory sensitivity, while no significant effects emerged for sex or education. Findings support the feasibility of the Italian SPQ-short and highlight the relevance of sensory sensitivities in adult autism.

Keywords: sensory processing; autism spectrum; hyposensitivity; hypersensitivity; autism in adulthood

1. INTRODUCTION

One of the defining clinical features for Autism Spectrum Disorder (ASD) is an unusual response to sensory stimuli (American Psychiatric Association, 2013, 2022). These sensory anomalies have been described in relation to hearing, vision, touch, taste, and smell (O'Neill & Jones, 1997), proprioception, and interoception (Blanche et al., 2012). Such atypical sensory responses often emerge between 6 to 12 months of age and can serve as early indicators of ASD in young children (O'Neill & Jones, 1997). ASD individuals may exhibit hypersensitivity (extremely heightened sensitivity) or hyposensitivity (diminished sensitivity) and experience severe sensory overload.

Sensory differences can influence how autistic individuals perceive and process information and interact with their environments. Additionally, they can profoundly affect an individual's life, limiting participation in community life and recreational activities, social and family interactions, and increasing the likelihood of engaging in challenging behaviors at the expense of adaptive behaviors (Jones et al., 2020; Howe & Stagg, 2016; Kinnealey et al., 2011; Kwakye et al., 2011).

For example, sensory differences can negatively impact schooling (Jones et al., 2020): auditory hyper-reactivity in the classroom can interfere with their ability to learn, causing concentration difficulties, anxiety, and discomfort (Howe & Stagg, 2016). Excessive sensory reactivity has also been linked to higher rates of depression and anxiety (Kinnealey et al., 2011). Identifying the difficulties and specificities of sensory processing in autistic individuals allows for the development of targeted interventions to improve their quality of life and learning experiences. This includes designing living, school and working environments tailored to address identified sensory issues (Tavassoli et al., 2014a).

Common diagnostic tools for ASD, such as the Autism Diagnostic Observation Scale (ADOS; Lord et al., 1989) and the Autism Diagnostic Inventory-Revised (ADI-R; Rutter et al., 2003), include elements related to sensory processing. However, they do not offer detailed insights into the sensory processing experiences and how they relate to daily life.

Various tools have been developed to analyze the sensory profile of autistic adults (Gunderson et al., 2023). Currently, there are no available tools in Italian specifically designed to assess sensory processing in autistic adults.

Recently, the Sensory Perception Quotient (SPQ) has been developed as a self-assessment scale (Tavassoli et al., 2014a). This tool was created by Tavassoli et al. (2014a) to study and quantify sensory perception in adults with autism, providing professionals with a useful intervention tool. The SPQ assesses basic sensory sensitivity across five senses (touch, smell, taste, hearing, vision), excluding measurements of social and affective responses related to sensory experiences.

The full version of the scale comprises 92 items, with half assessing hypersensitivity to stimuli and the other half assessing hyposensitivity. A shorter version consisting of 35 items has also been developed (Tavassoli et al., 2014a). For 35 item SPQ-Short version the score is assigned on a Likert scale ranging from 0 to 3 (0=strongly agree; 1=agree; 2=disagree; 3=strongly disagree). Items 7, 13, 14, 22, 27 and 33 have reversed scoring. For these items, a score of 0 (“strongly agree”) corresponds to hyposensitivity (reduced sensory sensitivity); while a score of 3 (“strongly disagree”) corresponds to hypersensitivity (heightened sensory sensitivity).

In the original version, a total score for SPQ-Short version is provided. A lower total score indicates hypersensitivity to various sensory stimuli. This means that the individual reacts more intensely to or perceives sensory stimuli more strongly than average. Conversely, a higher total score indicates hyposensitivity, meaning reduced sensitivity or perception of sensory stimuli compared to the norm.

The SPQ-short version has been translated and validated in German (Klein et al, 2022) and Dutch (Weiland et al, 2020).

This study aims to conduct a preliminary pilot assessment of the Italian short version of the SPQ, exploring its feasibility and initial psychometric properties in a sample of autistic and neurotypical adults.

2. METHOD

2.1 Participants

The study involved 156 participants divided into two groups: 79 autistic individuals (40 males, 39 females) and 77 neurotypical individuals (42 males, 35 females). The age range for the autistic group was 18-55 years ($M = 33.2$, $SD = 8.7$), and for the neurotypical group, it was 19-54 years ($M = 32.7$, $SD = 9.1$). Educational backgrounds varied across both groups, with the majority having completed higher education. 5 out of the 79 participants had a diagnosis of ASD with level 2 of support (4 males, 1 female), while 74 had a diagnosis of ASD with level 1 of support (45 males, 29 females). The two experimental groups did not differ significantly regarding sex ($F [1, 154] = 1.61$, $p = .206$), age ($F [1, 150] = 3.66$, $p = .057$) and educational level ($F [1, 152] = 1.07$, $p = .304$). The autistic participants were recruited from current or former patients from a Regional Center for Autism Spectrum Disorder, operated into the national mental health system specializing in ASD in adulthood services. The Center offers comprehensive clinical assessment, psychological, and educational interventions

for individuals with autism. Most participants were referred by general psychiatrists for initial ASD assessments or follow-up evaluations. Diagnostic criteria adhered strictly to DSM-5 guidelines (APA, 2013), utilizing clinical history, interviews, cognitive assessments using WAIS-IV (Wechsler, 2008) and diagnostic tools such as ADI-R (Rutter et al., 2003), ADOS module 4 (Lord et al., 2002), or RAADS (Ritvo et al., 2011), within a structured diagnostic pathway (multistep network model, Keller et al., 2020).

The present retrospective study was conducted using clinical data previously collected. The data were accessed for research purposes between August 2022 and March 2024 and were fully anonymized prior to analysis.

The study complies with the principles of the Declaration of Helsinki and data protection laws (EU Regulation 2016/679). Verbal informed consent was obtained from all participants and was documented in the patients' clinical records. At the time of data collection, no specific ethics committee approval was required, as the data were gathered as part of a routine clinical assessment conducted within the framework of the public health service.

The assessment was a standard component of clinical care. Subsequently, ethical approval was obtained from the local ethics committee to authorize research activities carried out within our outpatient clinic, including the use of these previously collected clinical data for research purposes. To be eligible for the study, all participants received a formal clinical ASD diagnosis based on DSM-5 criteria. Individuals with co-occurring mental health conditions ($n=25$) were included only if symptoms were either in remission or minimally impacting daily functioning. Controls were recruited from various workplaces and through acquaintances of the study's authors, with inclusion criteria specifying ages between 18 and 50 years, Italian as their native language, and an educational attainment of ≥ 8 years. As an exclusion criterion, we used the score on the RAADS-R scale (see Table 1). Out of the 98 participants who completed the RAADS-R, 21 were excluded because they scored above the cutoff on the total scale (>65).

Table 2 presents all demographic variables and characteristics of the final sample.

Table 1. RAADS-R control group scores

	RAADS_tot	RAADS_SR	RAADS_CI	RAADS_L	RAADS_SM
Mean±SD	34.2±12.8	16.1±7.63	8.45±4.37	2.36±2.16	7.35±5.42
Minimum	3	1	0	0	0
Maximum	59	36	20	8	28

Table 2. Descriptive analyses of the control and experimental groups (means and standard deviations)

Group	Sex	Age	Educational Level
TD	M	32.4 (7.5)	13.8 (2.58)
	F	29.8 (7.94)	13.1 (1.94)
ASD	M	28.8 (6.84)	13.3 (1.89)
	F	29.2 (6.78)	12.7 (2.39)

2.2 Procedure

Participants completed the SPQ-short version, and the neurotypical group additionally completed the RAADS-R. The SPQ measures sensory processing across five domains: Taste, Smell, Vision, Hearing, and Touch. Higher scores indicate greater sensory sensitivity. The Ritvo Autism Asperger Diagnostic Scale - Revised (RAADS-R) was used to ensure neurotypical participants did not exhibit autistic traits, with a cut-off score of <65 on the global scale. The RAADS-R is a self-report questionnaire designed to aid in the identification of individuals with ASD and related conditions (Eriksson et al., 2013).

2.2.1 Adaptation and translation of the short SPQ

The original short version of the SPQ (Tavassoli et al., 2014a) consists of 35 items assessing sensory sensitivity across multiple modalities. The translation of the SPQ-short version into Italian was carried out in line with core principles of linguistic equivalence, albeit with some deviations from formal cross-cultural adaptation protocols.

The original English version of the questionnaire was first translated into Italian by a researcher with clinical experience in ASD. This initial translation was then reviewed and refined in collaboration with a medical professional with expertise in ASD, to ensure clinical relevance and accuracy. Subsequently, a native English speaker, who had no prior access to the original version, performed a back-translation of the Italian items into English. This step served to verify the semantic and conceptual equivalence between the translated and original versions of the items. The back-translation was carefully examined to confirm the correspondence of meaning across the two languages. Importantly, no substantial modifications to the original content or construct coverage were made beyond faithful linguistic translation.

The Italian version was subsequently administered to a group of adult participants as part of a separate clinical project. Although the primary aim of this administration was not to assess clarity or comprehensibility, the exposure of the tool in that context allowed for informal confirmation of its usability in an applied setting. No further modifications were made following this initial use.

2.2.2 Scoring procedure

Consistent with the original SPQ scoring approach, each item is rated on a 4-point Likert scale reflecting the frequency or intensity of sensory experiences. Several items are reverse-coded to ensure that higher scores uniformly indicate greater sensory sensitivity or atypical sensory experiences. The total SPQ score is calculated as the sum of all item scores after applying reverse coding where appropriate. Additionally, the short version retains subscale scores corresponding to specific sensory modalities - taste, smell, vision, hearing, touch, and balance - computed as the sum of scores for the items assigned to each modality. Higher scores on both total and subscale measures indicate higher levels of sensory sensitivity (Tavassoli et al., 2014b).

2.2.3 Internal structure of the tool

The short version of the SPQ was originally designed to reflect five sensory domains (i.e., taste, smell, vision, hearing, touch) supported by Exploratory Factor Analyses (EFA) in the source population (Robertson & Simmons, 2015). In this study, we further examined the internal structure of the Italian version using EFA. Results indicated adequate sampling adequacy (Kaiser-Meyer-Olkin = .738) and significant sphericity (Bartlett's test, $p < .001$), confirming the suitability of the data for factor analysis. The scree plot showed an inflection point after approximately two to three factors, suggesting a

preliminary multidimensional structure. Factor loadings revealed interpretable subdimensions consistent with the sensory modalities targeted by the SPQ, although some cross-loadings were observed, reflecting the exploratory and preliminary nature of this adaptation in an Italian sample.

2.3 Statistical analysis

All analyses were conducted using IBM SPSS Statistics for Windows, Version 29.0.1.0 (IBM Corp., Armonk, NY, USA) and Jamovi (The Jamovi Project, 2022).

Descriptive statistics were computed for all study variables and correlations were computed between the subscales of the SPQ-short version and the sociodemographic characteristics. To assess internal consistency, Cronbach's alpha, standardized item alpha, mean inter-item correlations, item-total correlations, and split-half reliability with Spearman-Brown correction were calculated. The internal structure of the Italian short version of the SPQ was explored using EFA with principal axis factoring and direct oblimin rotation.

To examine associations among the five SPQ-short version subscales and with sociodemographic variables (age, years of education), Pearson's correlations were calculated.

To compare autistic and neurotypical groups on SPQ-short version scores, initial one-way analyses of variance (ANOVAs) were conducted. We then conducted General Linear Models (GLM) for the total score and each subscale, with group as the fixed factor, and age, sex, and years of education included as covariates. Interaction terms between sex and group were also included to explore potential moderating effects.

Finally, to address potential Type I error inflation due to multiple comparisons, we conducted a multivariate analysis of covariance (MANCOVA) with the five SPQ subscale scores as dependent variables, group as the fixed factor, and age, sex, and years of education as covariates. This multivariate approach allowed us to evaluate overall group differences across the combined set of subscales while controlling for confounders.

3. RESULTS

The correlation table (Table 3) presents the correlations between the subscales of the SPQ-short version and the sociodemographic characteristics of the participants. Results indicated moderate, statistically significant positive correlations among all subscales (all $p < .001$), suggesting that while the domains are distinct, individuals with higher sensitivity in one modality tend to

report higher sensitivity in others. These findings support the partially correlated, multidimensional nature of the SPQ-short version subscales in this sample, consistent with the theoretical model in which different sensory modalities represent related but distinct aspects of sensory processing.

No significant correlations were found between the level of education and the SPQ-short version subscales. Age showed a small but significant negative correlation with the olfactory subscale ($r = -0.147, p < .005$), indicating that older participants tended to report lower subjective sensitivity or reactivity to olfactory stimuli. No other subscale showed significant correlations with age.

Table 3. Correlational matrix of SPQ subscales and total scale and socio-demographic characteristics

	SPQ TOT	SPQ TASTE	SPQ SMELL	SPQ VISION	SPQ HEARING	SPQ TOUCH	Educational Level	Age
SPQ_TOT	-	-	-	-	-	-	-	-
SPQ_TASTE	0.632***	-	-	-	-	-	-	-
SPQ_SMELL	0.826***	0.493***	-	-	-	-	-	-
SPQ_VISION	0.691***	0.278***	0.463***	-	-	-	-	-
SPQ_HEARING	0.781***	0.477***	0.584***	0.572***	-	-	-	-
SPQ_TOUCH	0.828***	0.532***	0.592***	0.517***	0.617***	-	-	-
Educational Level	-0.039	-0.026	0.018	0.062	-0.014***	-0.101	-	-
Age	-0.029	0.012	-0.147	-0.020	0.086	-0.018	0.017	-

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

As shown in table 4, autistic individuals had lower mean scores in the total scale of SPQ-short version ($F [1,154] = 15.49, p < .001$) and in Vision ($F [1,154] = 51.57, p < .001$), Hearing ($F [1,154] = 32.93, p < .001$) and Touch ($F [1,154] = 15.49, p < .001$) domains compared to neurotypical individuals. No statistically significant differences were detected between groups when Taste and Smell domain are considered.

Table 4. Descriptive statistics of the control and experimental groups (means and standard deviations)

SPQ scales	Group		F	gdl1	gdl2	p
	TD	ASD				
SPQ Total Scale	53.19 (13.62)	44.38 (14.35)	15.49	1	154	<.001
SPQ Taste	4.86 (2.13)	4.38 (2.37)	1.75	1	153	0.187
SPQ Smell	15.35 (4.20)	14.43 (5.44)	1.40	1	146	0.238
SPQ Vision	10.34 (2.61)	7.29 (2.69)	51.57	1	154	<.001
SPQ Hearing	9.30 (2.76)	6.72 (2.85)	32.93	1	154	<.001
SPQ Touch	14.08 (4.42)	11.56 (4.96)	11.27	1	153	<.001

A GLM was conducted to examine the effect of the group on the total score of the SPQ-short version (SPQ_TOT), while controlling for age, sex, and educational level. The model revealed a significant main effect of the group on the total score of the SPQ-short version ($F [5, 150] = 3.838, p = .003, \eta^2p = .113$). Neurotypical individuals reported significantly higher total scores of SPQ-short version ($M = 53.19, SD = 13.62$) compared to autistic individuals ($M = 44.38, SD = 14.35$), with a mean difference of -9.889 ($SE = 2.313, p < .001, \beta = -0.6757$).

In line with previous findings, these results indicate that the group is a significant predictor of the total score of SPQ-short version, with autistic individuals reporting higher sensory perception overall. age, sex, educational level, and the interaction between sex and group did not significantly predict the SPQ-short version total score. The GLM for the SPQ-short version taste subscale (SPQ_TASTE) did not reveal significant differences between groups ($F [5, 150] = 1.538, p = .181, \eta^2p = .049$). Although, none of the predictors were significant for the SPQ-short version taste subscale, data show that the sex variable approaches statistical significance ($p = .056$), highlighting comparable scores between autistic males ($M = 4.84, SD = 2.82$) and neurotypical males ($M = 4.92, SD = 2.23$), and a greater difference between the scores of autistic females ($M = 3.63, SD = 2.28$) and neurotypical females ($M = 4.78, SD = 2.04$).

Similarly, the GLM for the SPQ-short version smell subscale (SPQ_SMELL)

indicated no significant differences between groups ($F [5, 150] = 1.552, p = .177, \eta^2p = .049$). Although the group effect was not significant, age was found to be a significant predictor for the SPQ-short version smell subscale ($p = .048$). This indicates that age has a small but significant negative impact on the smell perception scores, suggesting that as participants age, their perception of smell slightly decreases.

For the SPQ-short version vision subscale (SPQ_VISION), the GLM revealed significant group differences ($F [5, 150] = 11.378, p < .001, \eta^2p = .275$). The GLM for the SPQ-short version hearing subscale (SPQ_HEARING) also demonstrated significant group differences ($F [5, 150] = 3.107, p = .011, \eta^2p = .094$). Finally, the GLM for the SPQ-short version touch subscale (SPQ_TOUCH) indicated significant differences between groups ($F [5, 150] = 3.107, p = .011, \eta^2p = .094$). None of the predictors have a significant impact on the vision, hearing and touch SPQ-short version subscales.

The short version of the SPQ showed good internal consistency in this Italian sample. Cronbach's alpha was .887, and the standardized item alpha was .889. Item-total correlations ranged from approximately .19 to .58, indicating generally adequate item contribution to the overall scale. The mean inter-item correlation was consistent with recommended values for psychological scales. Split-half reliability was also strong, with a Spearman-Brown coefficient of .863.

Moreover, an EFA using principal axis factoring with direct oblimin rotation was conducted on the 35 items. The Kaiser-Meyer-Olkin measure of sampling adequacy was .738, indicating acceptable suitability for factor analysis. Bartlett's test of sphericity was highly significant ($\chi^2(595) = 2482.8, p < .001$), supporting factorability of the correlation matrix.

The scree plot showed an inflection ("elbow") after approximately 2–3 factors, suggesting a preliminary multidimensional structure consistent with the theoretical sensory domains measured by the SPQ. The analysis extracted multiple factors with eigenvalues greater than 1, cumulatively explaining around 54% of the variance. While some cross-loadings were observed, the pattern of loadings suggested interpretable subdimensions aligned with sensory modalities such as taste, smell, touch, hearing, and vision.

Also, between-group comparisons were performed using ANOVA and GLM analyses to evaluate the effect of group on SPQ total and subscale scores, controlling for age, sex, and educational level. Results showed significant differences between groups on the SPQ total score and multiple subscales, indicating higher sensory processing difficulties in the ASD group. These findings support the feasibility and informativity of the short version of the SPQ in distinguishing between autistic and neurotypical adults in this Italian sample.

Lastly, to address the risk of inflated Type I error due to multiple comparisons, we conducted a MANCOVA with the five SPQ-short version

subscale scores as dependent variables, group as the fixed factor, and age, sex, and years of education as covariates.

The multivariate test revealed a significant overall group effect (Pillai's trace = .308, $F[5,159] = 14.161$, $p < .001$, $\eta^2 p = .308$), indicating robust differences in the combined sensory subscale scores between autistic and neurotypical participants. Among covariates, age also showed a significant multivariate effect (Pillai's trace = .072, $F[5,159] = 2.460$, $p = .035$), suggesting a small but significant influence on the overall sensory profile. sex and years of education did not show significant multivariate effects.

Follow-up univariate tests (interpreted cautiously given multiple testing) showed significant group differences on the Vision ($F = 13.699$, $p < .001$, $\eta^2 = .252$), Hearing ($F = 8.405$, $p < .001$, $\eta^2 = .171$), and Touch ($F = 3.414$, $p = .010$, $\eta^2 = .077$) subscales. No significant differences were observed on the Smell ($F = 1.803$, $p = .131$) or Taste ($F = .860$, $p = .489$) subscales. These results suggest that autistic participants reported heightened sensitivity specifically in visual, auditory, and tactile modalities, consistent with theoretical expectations for sensory processing differences in autism.

4. DISCUSSION

This study aimed to explore sensory processing differences between Italian autistic and neurotypical adults using the short form SPQ (Tavassoli et al., 2014b). Our findings, in line with existing literature (Tavassoli et al., 2014b; Klein et al., 2022; Weiland et al., 2020; American Psychiatric Association, 2013, 2022) confirmed that individuals with ASD exhibit heightened hypersensitivity compared to neurotypical individuals. Significant differences found in total SPQ-short version scores and in specific subscales (i.e., vision, hearing, and touch) suggest that sensory hypersensitivity is more pronounced in specific modalities. This heightened sensory sensitivity may contribute to the sensory overload often described by individuals on the autism spectrum, potentially impacting daily experiences and quality of life (Robertson & Simmons, 2015; Tavassoli et al., 2014a, 2014b)

Interestingly, no significant differences were found between autistic and neurotypical individuals in the taste and smell domains. This might indicate that sensory processing differences in autism are more pronounced in certain sensory modalities than others. Previous research has shown mixed results in these areas, suggesting that individual variability in sensory experiences among autistic individuals could influence these outcomes (Crane et al., 2009; Wiggins et al., 2009).

Heightened visual and auditory sensitivity often reported by individuals on the autism spectrum may explain some of the challenges they encounter in

stimulus-rich environments., where loud sounds and intense lights can become overstimulating and cause discomfort or concentration difficulties (Howe & Stagg, 2016). On the other hand, tactile hypersensitivity may lead to sensory overstimulation, resulting in lower tolerance for certain types of physical contact or the use of specific clothing materials, thereby affecting daily life and social interactions (Jones et al., 2020).

The Cronbach's alpha coefficient for the short version of the SPQ was 0.887, indicating high internal consistency and reliability of the instrument. Split-half reliability (Spearman-Brown coefficient = 0.863) and standardized item alpha also indicated strong internal consistency, supporting the reliability of the scale in this context. Mean inter-item and item-total correlations further suggested adequate homogeneity among items while preserving the expected multidimensionality.

The observed internal consistency supports the feasibility of using the questionnaire to assess self-reported sensory processing differences in adults with ASD and neurotypical individuals in this preliminary Italian sample. This preliminary adaptation into Italian, addressing the lack of equivalent tools in this language, provides initial evidence of its potential applicability in the Italian context and lays the groundwork for future research and clinical investigations. Correlations between the SPQ-short version subscales revealed strong associations across different sensory dimensions (taste, smell, vision, hearing, and touch), with values ranging from 0.278 to 0.828 (see Table 3).

This suggests that the various aspects of sensory perception measured may be closely related. It confirms the internal consistency of the questionnaire. Furthermore, the correlation table shows that sensory perceptions are generally independent of demographic variables such as education level and age, except for a slight decrease in smell sensitivity with age. This finding aligns with existing literature suggesting age-related changes in sensory experiences and warrants further investigation (Dan et al., 2021; Kondo et al., 2020).

Additionally, an EFA suggested a multidimensional structure consistent with the theoretical sensory domains measured by the SPQ. The scree plot indicated an inflection after approximately 2–3 factors, and factors with eigenvalues greater than 1 cumulatively explained around 54% of the variance. While some cross-loadings were observed, the pattern of loadings was broadly interpretable and aligned with sensory modalities such as taste, smell, touch, hearing, and vision. These findings support the construct's multidimensional nature in this preliminary sample and inform future refinement and validation work.

No significant differences in total SPQ-short version scores were found between males and females within the two groups, nor were there significant interactions between sex and group. However, the analysis of the taste subscale scores showed a trend toward significance concerning sex ($p = 0.056$),

indicating that autistic females may have slightly different taste sensitivity scores compared to autistic males and neurotypical individuals. Although not statistically significant, these sex differences may suggest a variation in sensory experiences between sexes, warranting further investigation with larger samples to confirm or refute these preliminary observations.

Moreover, to address the risk of Type I error due to multiple comparisons across subscales, we conducted a MANCOVA, controlling for age, sex, and years of education. The MANCOVA revealed a significant overall multivariate group effect, indicating robust differences in the combined sensory subscale scores between autistic and neurotypical participants even when controlling for demographic covariates. This analytic approach strengthens the confidence in the observed group differences while accounting for potential confounding variables.

These preliminary results suggest that the Italian SPQ-short version may be a feasible tool for assessing self-reported sensory processing differences, offering initial evidence that it can distinguish between autistic and neurotypical adults in this sample. While our study does not support direct clinical application at this stage, it highlights the potential value of using individualized sensory profiles in future research to inform more tailored intervention strategies aimed at improving quality of life for autistic individuals.

In summary, this study provides initial evidence of differences in sensory processing between autistic and neurotypical adults in Italy, particularly in vision, hearing, and touch. Our findings underscore the importance of considering sensory sensitivities when designing therapeutic environments and planning interventions, while also recognizing that further research is needed to fully validate the tool and explore its clinical utility.

This study has several important limitations that must be acknowledged. First, the sample size was relatively modest, and the recruitment methods constrain the generalizability of our findings to the broader Italian population of autistic and neurotypical adults.

Given these limitations, our results should be interpreted as preliminary and exploratory. We strongly encourage future research to replicate and extend these findings using larger, more representative samples drawn from multiple clinical and community contexts. Such studies would allow for more rigorous assessment of the psychometric properties of the Italian SPQ-short version, including external validity and normative data, and would help establish its potential utility in both clinical and research settings.

Acknowledgements

We thank all the people who took part in this study.

Funding

The authors did not receive any specific funding for this research.

Conflict of interest statement

The authors have no conflicts of interest to declare. All co-authors have seen and agree with the contents of the manuscript and there is no financial interest to report. We certify that the submission is original work and is not under review at any other publication.

REFERENCES

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (5th ed.)*. Arlington, VA: American Psychiatric Association. <https://doi.org/10.1176/appi.books.9780890425596>
- American Psychiatric Association. (2022). *Diagnostic and statistical manual of mental disorders (5th ed., text rev.; DSM-5-TR)*. American Psychiatric Publishing.
- Blanche, E. I., Reinoso, G., Chang, M. C., & Bodison, S. (2012). Proprioceptive processing difficulties among children with autism spectrum disorders and developmental disabilities. *American Journal of Occupational Therapy*, 66(5), 621–624. <https://doi.org/10.5014/ajot.2012.004234>
- Crane, L., Goddard, L., & Pring, L. (2009). Sensory processing in adults with autism spectrum disorders. *Autism*, 13(3), 215–228. <https://doi.org/10.1177/1362361309103794>
- Dan, X., Wechter, N., Gray, S., Mohanty, J. G., Croteau, D. L., & Bohr, V. A. (2021). Olfactory dysfunction in aging and neurodegenerative diseases. *Ageing Research Reviews*, 70, 101416. <https://doi.org/10.1016/j.arr.2021.101416>
- Eriksson, J. M., Andersen, L. M., & Bejerot, S. (2013). RAADS-14 Screen: Validity of a screening tool for autism spectrum disorder in an adult psychiatric population. *Molecular Autism*, 4(1), 49. <https://doi.org/10.1186/2040-2392-4-49>

- Gunderson, J., Worthley, E., Byiers, B., Symons, F., & Wolff, J. (2023). Self and caregiver report measurement of sensory features in autism spectrum disorder: A systematic review of psychometric properties. *Journal of Neurodevelopmental Disorders*, 15(1), 5. <https://doi.org/10.1186/s11689-022-09473-7>
- Howe, F. E., & Stagg, S. D. (2016). How sensory experiences affect adolescents with an autistic spectrum condition within the classroom. *Journal of autism and developmental disorders*, 46(5), 1656-1668. <https://doi.org/10.1007/s10803-015-2693-1>
- IBM Corp. (2022). IBM SPSS Statistics for Windows (Version 29.0.1.0) [Computer software]. Armonk, NY: IBM Corp.
- Jones, E. K., Hanley, M., & Riby, D. M. (2020). Distraction, distress and diversity: Exploring the impact of sensory processing differences on learning and school life for pupils with autism spectrum disorders. *Research in Autism Spectrum Disorders*, 72, 101515. <https://doi.org/10.1016/j.rasd.2020.101515>
- Keller, R., Chiericato, S., Bari, S., Castaldo, R., Rutto, F., Chiocchetti, A., & Dianzani, U. (2020). Autism in adulthood: clinical and demographic characteristics of a cohort of five hundred persons with autism analyzed by a novel multistep network model. *Brain sciences*, 10(7), 416. <https://doi.org/10.3390/brainsci10070416>
- Kinnealey, M., Koenig, K. P., & Smith, S. (2011). Relationships between sensory modulation and social supports and health-related quality of life. *American Journal of Occupational Therapy*, 65(3), 320–327. <https://doi.org/10.5014/ajot.2011.001370>
- Klein, C., Miczuga, T., Kost, M. S., Röring, H., Jarczok, T. A., Bast, N., et al. (2022). A German short-version of the "Sensory Perception Quotient" for adults with autism spectrum disorder. *Frontiers in Psychiatry*, 13, 781409. <https://doi.org/10.3389/fpsy.2022.781409>
- Kondo, K., Kikuta, S., Ueha, R., Suzukawa, K., & Yamasoba, T. (2020). Age-related olfactory dysfunction: Epidemiology, pathophysiology, and clinical management. *Frontiers in Aging Neuroscience*, 12, 208. <https://doi.org/10.3389/fnagi.2020.00208>
- Kwakye, L. D., Foss-Feig, J. H., Cascio, C. J., Stone, W. L., & Wallace, M. T. (2011). Altered auditory and multisensory temporal processing in autism spectrum disorders. *Frontiers in Integrative Neuroscience*, 4, 129. <https://doi.org/10.3389/fnint.2010.00129>
- Catherine Lord., Michael Rutter., Goode, S., Heemsbergen, J., Jordan, H., & Mawhood, L. (1989). *Autism Diagnostic Observation Schedule (ADOS)* [Database record]. *APA PsycTests*. <https://doi.org/10.1037/t54175-000>

- Rutter, M., Le Couteur, A., & Lord, C. (2003). *Autism Diagnostic Interview-Revised* (ADI-R). Los Angeles, CA: Western Psychological Services.
- O'Neill, M., & Jones, R. S. (1997). Sensory-perceptual abnormalities in autism: a case for more research?. *Journal of autism and developmental disorders*, 27(3), 283-293. <https://doi.org/10.1023/A:1025850431170>
- Robertson, A. E., & Simmons, D. R. (2015). The sensory experiences of adults with autism spectrum disorder: A qualitative analysis. *Perception*, 44(5), 569-586. <https://doi.org/10.1068/p7833>
- Riva Ariella Ritvo., Edward Ritvo., Guthrie, D., Ritvo, M. J., Hufnagel, D. H., McMahon, W., Tonge, B., Mataix-Cols, D., Jassi, A., Attwood, T., & Eloff, J. (2011). The Ritvo Autism Asperger Diagnostic Scale-Revised (RAADS-R): A scale to assist the diagnosis of autism spectrum disorder in adults: An international validation study. *Journal of Autism and Developmental Disorders*, 41(8), 1076-1089. <https://doi.org/10.1007/s10803-010-1133-5>
- Tavassoli, T., Hoekstra, R. A., & Baron-Cohen, S. (2014a). The Sensory Perception Quotient (SPQ): Development and validation of a new sensory questionnaire for adults with autism. *Molecular Autism*, 5(1), 29. <https://doi.org/10.1186/2040-2392-5-29>
- Tavassoli, T., Miller, L., Schoen, S. A., Nielson, D., & Baron-Cohen, S. (2014b). Sensory over-responsivity in adults with autism spectrum conditions. *Autism*, 18, 428-432. <https://doi.org/10.1177/1362361313477246>
- The jamovi project. (2022). *jamovi* (Version 2.3) [Computer software]. <https://www.jamovi.org>
- Wechsler, D. (2008). *Wechsler Adult Intelligence Scale—Fourth Edition (WAIS-IV)* [Database record]. APA PsycTests. <https://doi.org/10.1037/t15169-000>
- Weiland, R. F., Polderman, T. J., Hoekstra, R. A., Smit, D. J., & Begeer, S. (2020). The Dutch Sensory Perception Quotient-Short in adults with and without autism. *Autism*, 24(8), 2071-2080. <https://doi.org/10.1177/1362361320942085>
- Wiggins, L. D., Robins, D. L., Bakeman, R., & Adamson, L. B. (2009). Brief report: Sensory abnormalities as distinguishing symptoms of autism spectrum disorders in young children. *Journal of Autism and Developmental Disorders*, 39(7), 1087-1091. <https://doi.org/10.1007/s10803-009-0711-x>