

# Sensory Experiences Questionnaire – 3.0 – Polish Version – Factorial Structure and Correlations With Temperamental Traits

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## ABSTRACT

## KEYWORDS

autism spectrum  
sensory responsiveness  
middle childhood  
temperament

The current study was conducted on a group of 208 children with a diagnosis of the autism spectrum aged between 3 years and 6 years 11 months, with a view to validating the four-factorial structure of the Sensory Experiences Questionnaire – 3.0 – Polish Version (SEQ-3.0 – Polish Version). The following questionnaires completed by the children's parents/caregivers were used: SEQ-3.0 – Polish Version, the Child Behaviour Questionnaire – Very Short Form (CBQ-VSF), and a version of the EAS Temperament Survey for Children (EAS-C). The obtained results confirmed the four-factorial structure of the SEQ-3.0 – Polish Version: hyperresponsiveness (HYPER), hyporesponsiveness (HYPO), sensory interests, repetitions and seeking behavior (SIRS), and enhanced perception (EP). Not all of the items of the EP factor were found to have satisfactory loadings. Therefore, inferences about its presence in the structure of the SEQ-3.0 – Polish Version should be drawn with caution. All factors correlated with the temperamental traits of the children in the analyzed sample. The results suggest that in a group of children on the autism spectrum aged between 3 years and 6 years 11 months, the EP factor might not become manifest. Therefore, it is advisable that future studies be conducted with separate analyses for age subgroups.

It is in the very first works on individuals on the autism spectrum that abnormal responses to sensory stimuli were considered to be significant characteristics of their functioning (Asperger, 1944; Kanner, 1943). They are currently included in the set of diagnostic criteria for the autism spectrum (American Psychiatric Association, 2013; World Health Organization, 2018), and researchers are increasingly recognizing them as one of the earliest symptoms of the autism spectrum (Asaridou et al., 2022). More than 80 years of research have enabled the generation of a vast body of knowledge regarding the different levels of response – neural, physiological, perceptual, or behavioral – of a person on the autism spectrum to a sensory stimulus. What is emphasized is the high level of detail and specialization of the accumulated evidence (Beker et al., 2018; Cascio et al., 2016; Schauder & Bennetto, 2016). This complexity of the different levels of research often makes it difficult to relate the results of the individual analyses to each other.

Furthermore, researchers note that in the functioning of people on the autism spectrum, abnormal behavioral responses to sensory stimuli do not always coincide with abnormal physiological responses or impaired perception of the intensity of a particular stimulus (Dweyer et al., 2022; Espenhahn et al., 2022; Woodard et al., 2012). Therefore, it appears that a normal level of physiological or neurophysiological response to a sensory stimulus does not always entail a normal behavioral response in individuals on the autism spectrum. An abnormal behavioral response to a sensory stimulus, on the other

hand, does not always coincide with an abnormal physiological, and sometimes even neurological, response in this group of individuals.

It has also been observed that there are no differences in physiological and neurophysiological responses to sensory stimuli (measured with physiological arousal thresholds or event-related potentials, ERPs) between individuals on the autism spectrum and typically developing individuals, although differences are noticeable at the level of behavioral responses (Dweyer et al., 2022; Kadlaskar et al., 2021). It has also been noted that physiological responses do not differ in children who develop typically but have different behavioral sensory profiles (DeBoth et al., 2021).

At the same time, there is a growing body of evidence for the association of abnormal responses to sensory stimuli with difficulties observed in the behavior of individuals on the autism spectrum such as limited participation in daily activities (Choi & Jung, 2021; Ismael et al., 2018), anxiety and intolerance of uncertainty (MacLennan et al., 2021), problems in social situations, depression (Alateyat et al., 2022; Rossow et al., 2021; Zhai et al., 2021), behavioral problems (Fabbri-Destro et al., 2022), as well as with the severity of the autism spectrum symptoms (Neufeld et al., 2021).

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Therefore, it would appear that some of the abnormalities in the processing of sensory stimuli in individuals on the autism spectrum may only be evident at the level of behavioral responses and may additionally exacerbate other behavioral difficulties. Against this background, it seems reasonable that sensory responses should be measured in this group with the use of questionnaire tools that are sufficiently sensitive to behavioral responses to sensory stimuli.

A tool often used by researchers to measure the behavioral responses of a child on the autism spectrum to sensory stimuli is the Sensory Profile developed by Dunn (2014). The questionnaire is completed by parents/caregivers of the child to be diagnosed. It allows for the measurement of the intensity of the child's behavioral responses to sensory stimuli in terms of seeking, avoiding, sensitivity, and registration; the following modalities: auditory, visual, tactile, vestibular, proprioceptive, and oral sensitivity; as well as behavioral measurements: conduct, social emotional, and attentional. Depending on the age version, the tool can be used with children from birth to 14 years of age. Another tool commonly used by researchers for measuring the responses of children on the autism spectrum to sensory stimuli is the Sensory Experiences Questionnaire – 3.0 (Baranek, 2009). It is designed to measure sensory responses in children on the autism spectrum aged between 2 and 12 years in terms of the sensory response patterns of hyposensitiveness, hypersensitiveness, sensory interests, repetitions and seeking behaviors, and enhanced perception.

Also worth mentioning are two tools that are not specifically dedicated to individuals on the autism spectrum, but may also be used for measuring responses to sensory stimuli in this group of individuals: Sensory Processing 3-Dimensions Scale (Mulligan & Schoen, 2019) and Profil Sensoryczny Dziecka (lit. Child's Sensory Profile; Wiśniewska, 2015). The Sensory Processing 3-Dimensions Scale (Mulligan & Schoen, 2019) allows the measurement of responses to sensory stimuli in children between the ages of 3 and 12 years in a very broad range covering the dimensions of sensory modulation, sensory discrimination, and sensorily-determined motor responses. Profil Sensoryczny Dziecka (Wiśniewska, 2015) is a Polish questionnaire completed by the child's parent/caregiver. It is designed for children aged between 3 and 10 years. It is used to measure the child's response to sensory stimuli in terms of dyspraxia, tactile hypersensitiveness, visual-auditory-vestibular seeking, sensory-vestibular seeking, postural disturbances, olfactory-tactile-vestibular seeking, vestibular hypersensitiveness, and auditory hypersensitiveness.

Other available tools designed to measure a narrower range of sensory responses in individuals on the autism spectrum include the Sensory Perception Quotient (Tavassoli et al., 2014), Sensory Processing Scale (Schoen et al., 2014), and Interoception Sensory Questionnaire (Suzman et al., 2021). The Sensory Perception Quotient (Tavassoli et al., 2014) is a self-report tool intended for adults on the autism spectrum, allowing the measurement of the perception of stimuli for various modalities (auditory, visual, tactile, gustatory, and olfactory) in varying ranges (e.g., amplitude, frequency, precision, risk, etc.). The Sensory Processing Scale (Schoen et al., 2014), in turn, is aimed at measuring responses to sensory stimuli in children and adolescents on the autism

spectrum in the dimension of sensory modulation: overresponsivity, underresponsivity, and sensory craving/sensory seeking. It enables a detailed description of the individual's response to various stimuli: tactile, auditory, visual, vestibular, proprioceptive, gustatory, and olfactory. The Interoception Sensory Questionnaire (Suzman et al., 2021) is a brief, 20-item self-report tool used to assess the responses of adult individuals on the autism spectrum to internal bodily stimuli.

It was decided that one of the above-mentioned tools – the Sensory Experiences Questionnaire – 3.0 (Baranek, 2009) – would be translated and adapted to Polish version. This questionnaire was selected because of the response patterns (hyperresponsiveness, hyposensitiveness, sensory interests, repetitions and seeking behaviors, and enhanced perception) it measures, which seem to be consistent with the symptoms of sensory responsiveness specific to individuals on the autism spectrum or related to symptoms of the autism spectrum. The revealed correlation of both hyperresponsiveness and hyposensitiveness with the occurrence of traits of autism in children (Neufeld et al., 2021) indicates that these dimensions of sensory responsiveness may be particularly pronounced in individuals on the autism spectrum. In addition, the combination of sensory interests, repetitions, and seeking behaviors in a single dimension seems justified, as they can relate to similar ranges of a child's behavior. Indeed, it has been shown that repetitive and stereotyped behaviors and restricted interests in individuals on the autism spectrum can be explained by the intensity of their sensory seeking (Piccardi & Gliga, 2022). Exposing a person to repetitive stimulation, in turn, results in an intensification of their perception of stimuli (Meng et al., 2021). Enhanced perception may therefore be a cognitive response but one observable in the behavior of a person on the autism spectrum to a repetitive sensory stimulus.

This study aimed to validate the Sensory Experiences Questionnaire – 3.0 – Polish Version (SEQ-3.0 – Polish Version; Krzysztófik, 2022). The decision was also made to correlate the four predictable factors of the SEQ-3.0 – Polish Version with the results of the tools measuring temperament traits of the children in the sample: the Child Behaviour Questionnaire – Very Short Form (CBQ-VSF, Lipska et al., 2021) and the EAS Temperament Survey for Children (EAS-C, Oniszczenko, 2015). Due to the similar range of some of the temperamental traits and responsiveness to sensory stimuli measured with them, it was assumed that the results in these tools could be good measures of external validity for the SEQ-3.0 – Polish Version.

Two research questions were put forward:

1. Is the four-factorial model of sensory response patterns (hyperresponsiveness, hyposensitiveness, sensory interests, repetitions and seeking behaviors, and enhanced perception) of the original version of the Sensory Experiences Questionnaire – 3.0 (Baranek, 2009) also observable in the Polish version of this tool (Krzysztófik, 2022)?
2. Are the response patterns of the SEQ-3.0 – Polish Version (Krzysztófik, 2022; hyperresponsiveness, hyposensitiveness, sensory interests, repetitions and seeking behaviors, and enhanced perception) related to the temperamental traits of the children

assessed with the CBQ-VSF (Lipska et al., 2022; surgency, negative affectivity, and effortful control) and the EAS-C (Oniszczenko, 2015; emotionality, activity, sociability, and shyness)?

Hypotheses were formulated as follows:

1. H.1. The four-factorial model of sensory response patterns (hyperresponsiveness, hyporesponsiveness, sensory interests, repetitions and seeking behaviors, enhanced perception) of the original version of the Sensory Experiences Questionnaire 3.0 (Baranek, 2009) is observable in the Polish version of this tool. This hypothesis is supported by the absence of research evidence indicating a different configuration of response patterns to sensory stimuli among individuals on the autism spectrum of Polish descent.
2. H.2. The sensory response patterns of the SEQ-3.0 – Polish Version (Krzysztofik, 2022) are related to the temperamental traits of the children in the following ranges:
  3. H.2.1. The pattern of hyperresponsiveness (HYPER) is positively related to temperamental traits such as emotionality and shyness.
  4. H.2.2. The pattern of hyporesponsiveness (HYPO) is negatively related to effortful control.
  5. H.2.3. The sensory interests, repetitions, and seeking behaviors (SIRS) pattern is positively related to the temperamental traits: surgency and activity.
  6. H.2.4. The enhanced perception (EP) pattern is positively related to the temperamental traits: surgency and activity.

Research among typically developing Polish children revealed that children with high sensory hyperresponsiveness also exhibited high levels of emotionality and shyness (Kucharczyk, 2013). Children exhibiting sensory hyporesponsiveness show no response or a delayed response to a sensory stimulus (Ausderau et al., 2014). They may not respond to the stimulus at all or respond to it with significantly reduced intensity. They can therefore adapt quite easily to the environment without the need to make an effort or control their responses. Such traits are described by Rothbart (2011) in terms of low intensity of the trait of effortful control. High scores for the SIRS pattern are characteristic of children on the autism spectrum who actively seek repetitive stimulation (Ausderau et al., 2014). Children with high scores for this dimension may therefore exhibit high activity (understood as liveliness and energy expenditure, Oniszczenko, 2015) and high surgency (understood as, among other things, seeking new stimulation, Rothbart, 2011). It has been noted that enhanced and intense perception is activated in individuals on the autism spectrum, particularly upon stimulation with a repeated stimulus (Meng et al., 2021). Temperamental traits such as activity and surgency may be related to this pattern of response to sensory stimuli.

## METHOD

### Sample

The original SEQ-3.0 (Baranek, 2009) is designed for children on the autism spectrum aged between 2 and 12 years. It was decided that younger children (between the age of 3 years and 6 years 11 months)

would be included in the study, since in younger children on the autism spectrum, symptoms of abnormal responses to sensory stimuli tend to persist, and are less variable over time (McCormick et al., 2016). It was hypothesized that analyses based on data collected in a group of children with a fairly stable pattern of sensory response would provide more reliable results for the validation of the tool.

The sample consisted of 208 children with a diagnosis of the autism spectrum aged between 3 years and 6 years 11 months. The mean age of the children was 5 years 4 months ( $SD = 1.13$ ). The largest age subgroup was children aged between 6 years and 6 years 11 months (97 children, 46.63%). The smallest age subgroups, in turn, were children aged between 3 years and 3 years 11 months (33 children, 15.87%) and between 4 years and 4 years 11 months (35 children, 16.82%). Of all the children, 20.68% (43 children) were aged between 5 years and 5 years 11 months. The sample group of children was disproportionate in the size of the subgroups of girls (20.19%, 42 participants) and boys (79.81%, 166 participants). The children lived in medium-sized towns and villages (36.54% and 33.65%, respectively), as well as in small and large cities (16.83% and 12.98%, respectively). They attended kindergartens for children with special educational needs (46.15%), inclusive kindergartens or inclusive groups within kindergartens (38.46%), mainstream kindergartens (10.01%), inclusive schools or inclusive groups within schools (3.37%), and special care educational facilities (1.92%). The participants had a diagnosis of autism, infantile or early childhood autism (79.80%), Asperger's syndrome (11.54%), and atypical autism (8.66%). The type of diagnosis was provided by the parent/caregiver completing the questionnaire exactly as it appears in the child's medical records. The vast majority of the children communicated exclusively verbally (66.83%). Some of them additionally used alternative communication (3.84). Some of the children also communicated exclusively with an alternative communication system (18.27%) or using their own ways (10.10%). Two parents did not notice any signs of communication from their child (.96%).

## Research Tools

The SEQ-3.0 - Polish Version (Krzysztofik, 2022) is a tool measuring the level of sensory responsiveness in children on the autism spectrum. It is completed by the child's parent/caregiver. The level of sensory responsiveness is assessed in terms of four patterns: hyperresponsiveness (HYPER), hyporesponsiveness (HYPO), sensory interests, repetitions and seeking behaviors (SIRS), and enhanced perception (EP). Specific scores are also described in terms of the following sensory modalities: auditory, visual, tactile, gustatory/olfactory, and vestibular/proprioceptive, and two contexts – social and nonsocial. Responses are indicated on a 5-point Likert scale. The result is the mean score obtained by the child on each of the four scales. There are also some additional items that require descriptive responses analyzed qualitatively. In the present study, satisfactory values of Cronbach's  $\alpha$  were obtained for this tool (HYPER = .88, HYPO = .86, SIRS = .89, EP = .63).

The Polish version of CBQ-VSF (Lipska et al., 2022) is a shortened version of the Children's Behavior Questionnaire (Rothbart et al., 2001). It consists of 36 items organized into three scales: surgency,

negative affectivity, and effortful control. The questionnaire is completed by the child's parent/caregiver indicating their responses on a 7-point scale, where 1 is an entirely false description of the child and 7 is entirely true. The result is the mean score obtained by the child on each of the three scales. All scales have satisfactory Cronbach's  $\alpha$  values exceeding .60 (Lipska et al., 2022).

The Polish version of the EAS-C Buss and Plomin (Oniszczenko, 2015) is a short 20-item questionnaire completed by the child's parent/caregiver. The results make it possible to describe the child's temperament in terms of four traits: emotionality, activity, sociability, and shyness. The parents mark their answers on a 5-point scale. The result is the sten score obtained by the child on each of the four scales. All scales have satisfactory Cronbach's  $\alpha$  values exceeding .47 (Oniszczenko, 2015).

The sociodemographic datasheet consisted of questions addressed to the child's parent/caregiver concerning: the type of educational institution the child attends, the child's method of communication, and the family's place of residence.

## Procedure

The original version of the Sensory Experiences Questionnaire – 3.0 (Baranek, 2009) was translated into Polish by a group of three professionals – psychologists and sensory integration therapists working with children on the autism spectrum. The Polish version was back-translated into English and, together with the Polish version, submitted to the author of the original version – Prof. G. Baranek – for assessment. She approved the translation. The tool prepared in this way was provided to parents and caregivers of 20 children on the autism spectrum aged between 3 and 7 years. The parents were asked to complete the questionnaire and write down their comments. None of the parents made any comments. Therefore, it was decided that the tool would be used without any changes in the study.

The study was carried out in 25 different educational and therapeutic institutions (kindergartens for children with special educational needs, inclusive kindergartens or inclusive groups within kindergartens, mainstream kindergartens, inclusive schools or inclusive groups within schools, and special care educational facilities) located in central, eastern, and southern Poland.

Parents or caregivers of the children in the study were provided with detailed written information about the conditions of the study. They were assured of the anonymity of the research. After giving their written consent to participate in the study, the parents/caregivers of the children were asked to complete a set of three tools and a sociodemographic datasheet, which were given to them through their therapist or teacher. The type of diagnosis obtained by the child was provided by the parent/caregiver completing the questionnaire exactly as it appears in the child's medical records (diagnosis obtained at a diagnostic center). They returned the completed sets to the same teacher or therapist from whom they had received them. Some parents asked the person conducting this study for written feedback on their child's results.

The research project was approved by the Research Ethics Committee at the Institute of Psychology at the John Paul II Catholic University of Lublin, Poland.

## Statistical Analyses to Test the Hypothesis on the Structure

The measurement model of the SEQ-3.0 - Polish Version was evaluated with a confirmatory factor analysis (CFA). The basic measurement model of the SEQ-3.0 comprises four correlated latent variables representing four sensory response patterns: HYPER (31 items), HYPO (18 items), SIRS (31 items), and EP (12 items).

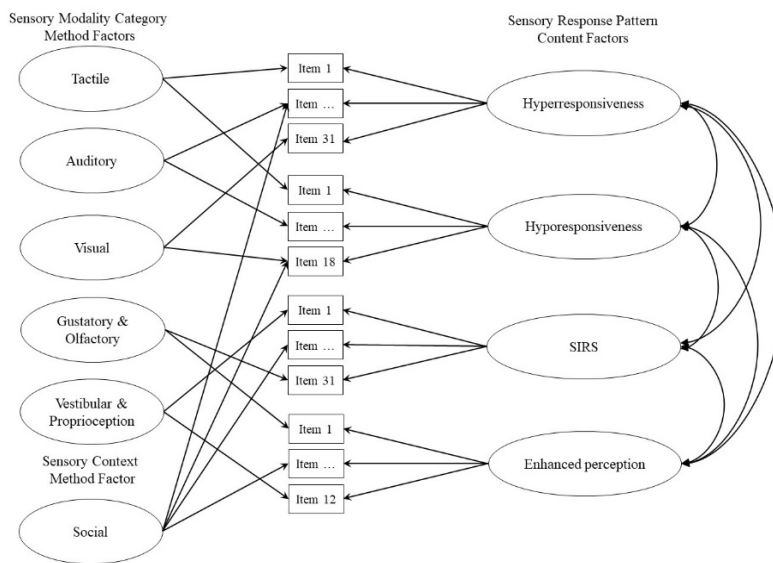
In the SEQ-3.0, six method biases can be identified (Ausderau et al., 2014): five regarding the sensory modality categories (i.e., tactile, auditory, visual, gustatory & olfactory, and vestibular & proprioception) and one regarding the sensory context (i.e., some items are regarding social context and some are not).

It is recommended to account for this method bias in the CFA model through the inclusion of an orthogonal (i.e., uncorrelated) latent variable, which is loaded to the same extent by all items expected to be influenced by the method bias (Podsakoff et al., 2012). This is done through constraining the equality of the factor loadings on the method factor. Within the current model, six such latent variables were included, which not only were orthogonal to the content factors (i.e., sensory response patterns) but also were constrained to be unrelated one to another. A graphical representation of the tested measurement model is provided in Figure 1. The model was estimated using the robust maximum likelihood estimation. No covariances between the residuals nor cross-loadings between any factors were introduced within the model. The analysis was carried out in Mplus v. 7.2. (Muthén & Muthén, 2012).

In the assessment of whether the analyzed measurement model fits the data well or not, the commonly reported fit indices were considered, that is, the root mean square error of approximation (RMSEA) and the standardized root mean square residual (SRMR), in which values below .08 and .10, respectively, suggest an acceptable model fit to the data (Schermelleh-Engel et al., 2003). As was previously done in the literature (Ausderau et al., 2014), the estimates of the comparative fit index are not reported, as they are penalized for each estimated parameter within the model. In other words, its estimates are artificially low and thus, uninterpretable, in models having a high number of degrees of freedom (Kenny & McCoach, 2003).

## RESULTS

The fit indices suggested an acceptable fit to the data,  $\chi^2(4082) = 8333.01, p < .001, RMSEA = .071 [.069, .073]; SRMR = .099$ . The standardized factor loadings are presented in Table 1. The strength of the factor loadings was mostly satisfying for HYPER (i.e., there were 29/31 loadings with a strength of  $> .30$ ) and HYPO (i.e., there was only 1/18 loading with a strength of  $< .30$ ), acceptable for SIRS (i.e., there were 6/31 loadings with a strength of  $< .30$ ) and poor for EP (i.e., there were 7/12 loadings with a strength of  $< .30$ ). Thus, it could be concluded that the hypothesized measurement model reproduced well with regard to all factors but EP, which needs to be interpreted with caution. Satisfactory values of Cronbach's  $\alpha$  were obtained for the above factors (HYPER = .88; HYPO = .86; SIRS = .89; and EP = .63).

**FIGURE 1.**

Conceptual representation of the tested measurement model of the SEQ-3.0.

Note. The current figure is conceptual and does not reflect the real order of items.

The amount of variance captured by the method factors varied, from the gustatory/olfactory factor accounting for almost a fifth of the variance (i.e., 18.48%), to the social method factor, which accounted only for 2.89% of the variance. The remaining method factors accounted for the following amounts of variance: auditory = 12.96%, visual = 6.76%, tactile = 5.29%, and vestibular/proprioception = 3.24%. Thus, it could be concluded that the sensory modality, especially gustatory/olfactory and auditory, accounted for a considerable amount of variance, while the effects of the remaining sensory modality and sensory context method factors were visibly weaker as compared to these two.

It was found that while HYPER, HYPO, and SIRS were all positively related one to another, all of these factors were unrelated to EP. Despite this, results provide support for the factorial structure of the SEQ-3.0 (see Table 2).

In the next step, model fit was assessed after removing items with loadings of less than .30. Items that were not considered in these analyses were: 73, 94, 7, 41, 60, 64, 65, 67, 24, 33, 48, 66, 70, 88, and 90. The following model fit indices were obtained,  $\chi^2(3003) = 9081.11$ ,  $p < .001$ , RMSEA = .067 [.065, .070], SRMR = .090. The values of Cronbach's  $\alpha$  were as follows: HYPER = .87, HYPO = .86, SIRS = .89, EP = .67. As a result of removing items with poor loadings, model fit indices improved to a negligible extent, Cronbach's  $\alpha$  values did not change or they improved only slightly. Therefore, it was therefore decided that all 97 items used in the original version of the SEQ 3.0 questionnaire would be retained in the Polish version.

Subsequent analyses that were conducted revealed the covariance of the four factors of the SEQ-3.0 – Polish Version with the results of the two temperament questionnaires: CBQ-VSF (Lipska et al., 2022) and EAS-C (Oniszczenko, 2015).

The HYPER factor positively correlated with shyness and negative affectivity. These correlations were weak. In contrast, the HYPO factor showed covariance with sociability and effortful control. These were weak negative correlations. The SIRS factor was weakly and positively correlated with surgency and activity. The EP factor, in turn, showed covariance with: surgency, negative affectivity, effortful control, emotionality, and activity. These were positive and mostly weak correlations, with the exception of the relationship with control, which had moderate strength (see Table 3).

## DISCUSSION

The results of the statistical analyses conducted confirmed the four-factorial structure of the SEQ-3.0 – Polish Version (Krzysztofik, 2022). H.1. is therefore confirmed, although there are some reservations regarding the EP factor, the presence of which requires further analyses. The CFA revealed the presence of four sensory response patterns in the SEQ-3.0 – Polish Version (Krzysztofik, 2022): HYPER, HYPO, SIRS, and EP. The values of the model fit indices were satisfactory.

Loadings of individual items had satisfactory (HYPER and HYPO) and acceptable (SIRS) values. Despite satisfactory model fit values, the loadings of seven (out of 12) items for the EP factor proved to be insufficient. This factor also showed no covariance with other factors – HYPER, HYPO, and SIRS – although correlations between the three factors were confirmed.

The confirmed presence of the HYPER and HYPO factors is consistent with the results of analyses of the original version of the tool (Ausderau et al., 2014). It also indicates that the traits of hyporesponsiveness and hyperresponsiveness are good measures of responsive-

**TABLE 1.**

Standardized Factor Loadings of the SEQ-3.0 – Polish Version

Hyperresponsiveness (HYPER)		Hyporesponsiveness (HYPO)		Sensory Interests, Repetitions, and Behavior (SIRS)		Enhanced Perception (EP)	
Item	$\lambda$	Item	$\lambda$	Item	$\lambda$	Item	$\lambda$
1	.56	4	.32	7	.25	3	.30
2	.41	8	.44	11	.32	5	.71
9	.66	14	.57	16	.35	6	.66
10	.58	22	.49	17	.68	12	.61
15	.42	23	.49	19	.61	20	.30
18	.31	31	.51	21	.65	24	.28
36	.34	34	.67	25	.32	33	.07
38	.53	43	.46	27	.67	48	.23
40	.42	53	.46	28	.66	66	.13
42	.26	56	.54	29	.37	70	.06
44	.58	58	.74	30	.60	88	.03
46	.41	69	.31	32	.54	90	.01
47	.45	74	.52	37	.44		
49	.42	82	.54	39	.30		
51	.53	84	.35	41	.29		
52	.33	86	.74	45	.50		
54	.40	91	.43	50	.61		
59	.32	94	.26	55	.50		
61	.35			57	.56		
63	.33			60	.27		
72	.34			62	.49		
73	.24			64	.24		
77	.41			65	.18		
81	.45			67	.10		
83	.53			68	.37		
87	.45			71	.44		
89	.51			76	.66		
92	.48			78	.40		
95	.42			79	.39		
96	.44			80	.51		
97	.43			85	.49		

Note. Although included in the model, factor loadings of the estimated method factors are not reported as they were all constrained to be equal.

**TABLE 2.**

Correlations Between the Latent Factors of the SEQ-3.0 – Polish Version

	1.	2.	3.	4.
1. HYPER	-			
2. HYPO	.54**	-		
3. SIRS	.39**	.65**	-	
4. EP	.03	-.15	.16	-

\*\*  $p < .001$

ness to sensory stimuli for children on the autism spectrum. It also is consistent with research evidence revealing an association of hyperresponsiveness and hyporesponsiveness with the presence of the traits of autism in children (Neufeld et al., 2021).

The intention of the authors of the original version (Ausderau et al., 2014) to combine sensory seeking with repetitive and stereotyped behaviors and restricted interests into a single factor was reflected in the acceptable loadings of the SIRS factor. These results are also in line with findings indicating that repetitive and stereotyped behaviors and restricted interests of individuals on the autism spectrum can be explained by their increased sensory seeking (Piccardi & Gliga, 2022).

The absence of satisfactory loadings for more than half of EP factor items supports the conclusion that this factor is present in the model with much less certainty. The presence of this factor was confirmed in the original version of the tool based on a study in a group of children on the autism spectrum aged between 2 and 12 years (Ausderau et al., 2014). What is more, enhanced perception was observed in adults with autistic traits (Meng et al., 2021). The low number of items with sufficient loadings in the EP factor observed in the present study may be due to the small sample size. The heterogeneity of this factor is also highlighted (Williams et al., 2023), which may have contributed to its failure to become fully manifest in younger children (under 7 years of age).

The results of the current study also confirmed the presence of method factors identical to those noted in the original tool (Ausderau et al., 2014), five in terms of sensory modalities (auditory, visual, tactile, gustatory/olfactory, and vestibular/proprioceptive) and one concerning social context.

It is also worth noting that the loadings of 16 of the 97 items had values below .30 (see Table 1). Their contribution to the four-factorial model of the SEQ-3.0 - Polish Version (Krzysztofik, 2022) should therefore be interpreted with less certainty.

The results of the current study revealed weak or moderate correlations of four factors of the SEQ-3.0 – Polish Version (Krzysztofik, 2022) with temperamental traits, thus confirming H.2.1–H.2.4. They indicate that in children on the autism spectrum, the temperamental traits of surgency, effective control, negative affect, emotionality, activity, sociability, and shyness had a rather weak relationship with the patterns of responses to sensory stimuli of HYPER, HYPO, SIRS, and EP.

Thus far, evidence has pointed to associations between temperamental traits and the severity of autism symptoms (Schwartz et al., 2009). The findings of the current study indicate that temperamental traits of children on the autism spectrum also showed an association with their responses to sensory stimuli. They are consistent with findings about differences in temperamental traits in children with typical development manifesting a variety of sensory dysfunctions (Kucharczyk, 2013).

Positive correlation between the HYPER factor from the SEQ-3.0 – Polish Version (Krzysztofik, 2022) and such temperamental traits as shyness and negative affectivity shows that children on the autism spectrum with sensory hyperresponsiveness (i.e. excessive response to or avoidance of sensory stimuli) may also exhibit as inhibition, restraint, a sense of tension, and discomfort in the presence of others, especially unfamiliar people. They may also have a tendency to experience nega-

**TABLE 3.**

Correlations Between SEQ 3.0 – Polish Version, CBQ - VSF, EAS - C Results

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
<b>SEQ 3.0</b>											
1. HYPER	-										
2. HYPO	.54**	-									
3. SIRS	.39**	.65**	-								
4. EP	.03	-.15	.16	-							
<b>CBQ-VSF</b>											
5. Surgency	-.15*	.10	.35**	.16*	-						
6. Negative Affectivity	.36**	-.04	-.01	.16*	-.02	-					
7. Effortful Control	.02	-.25**	-.03	.47**	-.09	.36**	-				
<b>EAS-C</b>											
8. Emotionality	.13	.09	.13	.18**	.16*	.48**	.17*	-			
9. Activity	-.14*	.02	.23**	.18**	.72**	-.05	-.02	.29**	-		
10. Sociability	-.24**	-.31**	-.10	.12	.23**	.08	.20**	-.01	.26**	-	
11. Shyness	.27**	.13	-.09	-.13	-.52**	.12	-.05	-.01	-.37**	-.65**	-

\*  $p < .05$ , \*\*  $p < .001$ .

tive emotions (sadness, fear, anger, irritability, or discomfort). In addition, the HYPER factor was weakly negatively correlated with such temperamental traits as surgency, activity, and sociability. Therefore, it can be assumed that children on the autism spectrum who are hyper-responsive to sensory stimuli may also have a low interest in what is new to them and may be less active in social situations, with low motor activity and low motivation to spend time with others. The covariance of the HYPO factor from SEQ-3.0 – Polish Version (Krzysztofik, 2022) with sociability and effortful control may suggest that children on the autism spectrum presenting delayed response or no response to sensory stimuli may also have low motivation to spend time with others and low ability to intentionally control their responses. The SIRS factor from the SEQ-3.0 – Polish Version (Krzysztofik, 2022) positively correlated with surgency and activity suggesting that children on the autism spectrum who show fascination with or actively seek certain types of sensory stimuli of a repetitive nature may also have an interest in new things and be active in social situations, as well as have high motor activity. The EP factor from the SEQ-3.0 – Polish Version (Krzysztofik, 2022) was positively correlated with surgency, negative affectivity, effortful control, emotionality, and activity. Therefore, children on the autism spectrum with an intense perception of specific sensory stimuli with a particularly strong focus on details may display the following temperamental traits: the ability to deliberately control their responses, as well as an interest in new things and activity in social situations, a tendency to experience negative emotions (sadness, fear, anger, irritation, or discomfort) and react with negative emotions (dissatisfaction, fear, or anger), and high motor activity (see Table 3).

## Limitations and Future Directions

Failure to obtain satisfactory loadings for more than half of EP factor items in the author's own analysis translates to insufficient confidence in inferring its presence in the structure of the SEQ-3.0 – Polish Version (Krzysztofik, 2022). As already observed in this study, such a

result of the analyses may have been caused by an insufficient sample size. Therefore, it is advisable to verify the four-factorial model based on research conducted in a larger sample of children, including older ones (up to 12 years of age). The findings suggest that in the group of children on the autism spectrum aged between 3 and 6 years, the EP factor might not manifest itself. Therefore, it would be advisable to conduct separate analyses in two age subgroups: one involving children aged between 2 and 6 years and another one involving children aged between 7 and 12 years.

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## DATA AVAILABILITY

Data are available at Institutional Repository of John Paul II Catholic University of Lublin (<http://hdl.handle.net/20.500.12153/4428>) under the licence CC BY-NC-ND 3.0 PL.

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