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The Turkish Short Version of the Sensory Experience Questionnaire: A Validity and Reliability Study in Children with Autism Spectrum Disorder

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ABSTRACT

Introduction: The purpose of the present study is to examine the psychometric properties of the Turkish form of the Sensory Experience Questionnaire Short Version (SEQv2.1), which is based on parent or primary caregiver reports, consisting of three sensory response patterns (hyporeactivity, hyperreactivity, and sensory seeking) previously validated in different clinical groups and the general population, on young children with autism spectrum disorder (ASD).

Method: The study participants consisted of 180 children with ASD and 65 typically developing children aged between 24 and 80 months. The children's sensory characteristics were measured using the SEQv2.1, which was filled out by their mothers. The study used the Childhood Autism Rating Scale (CARS) to examine concurrent criterion validity and confirm the children's ASD diagnosis. After the SEQv2.1 was translated, the questionnaire's validity was examined with construct and criterion validity, while its reliability was examined with Cronbach's alpha and McDonald's omega internal consistency coefficient.

Results: The analyses conducted to examine construct validity showed that the model fit indices for the questionnaire's three-factor structure were acceptable, but not all items had acceptable loading values. Furthermore, the sub-factors of the SEQv2.1 were moderately positively correlated with each other and highly positively correlated with the overall scale, and the mean scores of children with ASD and typically developing children from the sub-factors of the SEQv2.1 and the overall scale significantly differed from each other. The analyses performed for criterion validity demonstrated that the sub-factors of the SEQv2.1 and the overall scale were moderately positively correlated with the CARS. Finally, reliability analyses determined that the sub-factors of the SEQv2.1 were acceptable and the overall scale had a good level of internal consistency reliability.

Conclusion: The Turkish form of the SEQv2.1, which includes three sensory response patterns (hyporeactivity, hyperreactivity, and sensory seeking), is generally valid and reliable in determining the sensory characteristics of young children with ASD. However, since not all items have satisfactory loading values, it is thought that inferences regarding the Turkish version of the SEQv2.1 should be made more carefully. Furthermore, since this may be related to the participants' ages, it is recommended that future research be conducted with an older age group.

Keywords: Autism spectrum disorder, hyperreactivity hyporeactivity, Sensory Experience Questionnaire, sensory seeking, validity and reliability

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INTRODUCTION

Sensory characteristics are defined as difficulties or differences in the ability to record, integrate, and respond to sensory input (1). Sensory characteristics, which are present in multiple modalities such as auditory, visual, or tactile, are often categorized in the literature into three behavioral response patterns: hyporeactivity, hyperreactivity, and sensory seeking (2–8). Hyporeactivity is defined as a lack of orientation, decreased responses, or no response at all to sensory stimuli to which many individuals would respond (e.g. little or no reaction to touch, sound, or the sensation of movement). Hyperreactivity is characterized by excessive responses to sensory stimuli that many individuals would find harmless, as well as escape or avoidance behaviors (e.g. being overly sensitive or uncomfortable with sounds, textures, and lights) (3,4). Sensory seeking, on the other hand, is characterized by an intense or repetitive admiration for or desire for sensory stimuli, which can be excessive (e.g. showing an unusual interest in flashing lights or certain sounds) (3,7).

Highlights

- **A tool is needed to assess sensory traits in children with ASD.**
- **The Turkish SEQv2.1 is a valid and reliable measurement tool.**
- **SEQv2.1 measures hyperreactivity, hyporeactivity, and sensory seeking.**

Sensory characteristics differentiate in individuals with various developmental disabilities, including Autism Spectrum Disorder (ASD), as well as in the general population (2,3,9). However, those sensory characteristic differences, estimated to be present in approximately 70–

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95% of children with ASD, occur at higher rates compared to children with other developmental disabilities or typically developing children (2,7,9). It has been determined that the sensory characteristics observed in children with ASD cannot be characterized by a single behavioral response pattern, such as hyporeactivity, hyperreactivity, or sensory seeking. Instead, different behavioral response patterns may be observed, and sometimes multiple patterns can occur simultaneously in the same child (1,5,7).

Due to the core deficits of ASD, the influence of the social context on sensory characteristics has led to the formulation of conceptual models appropriate for this population. The sensory characteristics of children with ASD have been studied in both social (experiences of contact with people) and non-social contexts (experiencing loud noises or textured objects) (7–9). Over time, there has been an increasing number of remarkable findings suggesting that sensory characteristics observed across various sensory modalities in social and non-social contexts emerge in the early years in children with ASD and have the potential to serve as early behavioral markers that distinguish ASD (3,5,7,10). Ultimately, sensory characteristics have been recognized in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders as a diagnostically significant feature of ASD, under the domain of restricted and repetitive behaviors (11). Moreover, it has been determined that the level of early sensory characteristics and specific behavioral response patterns may have a progressive impact on the later development of social communication deficits, which is another major diagnostic criterion for ASD, and may increase the severity of ASD (6,12,13). Additionally, early sensory characteristics have been reported to negatively affect adaptive behavior and/or cognitive functioning in children with ASD as they grow older (2,5,14,15), limit participation in social activities for both the child and the family (16), and be associated with repetitive behaviors (17) and anxiety (18).

Considering the impact of sensory characteristics on the diagnosis, development, and quality of life of children with ASD, it is evident that assessing these characteristics for early intervention is of great importance for children with ASD and their families. A variety of measures, including surveys, direct observations, physiology, and neural reactivity, have been used to assess sensory characteristics in children with ASD (19). However, a recent systematic literature review revealed that in 80% of the 93 studies examined sensory characteristics in children with ASD, data were based on reports from parents or primary caregivers, with the Sensory Experience Questionnaire (SEQ) being one of the most commonly used parent-report scales (8,20). The key features that distinguish the SEQ from other parent-report scales include its ability to measure all sensory characteristics specific to ASD in both social and non-social contexts, and its applicability across a broader age range (8). Additionally, the SEQ is more robust in terms of psychometric properties compared to other scales (21).

There are different versions of the SEQ used in both typically developing and atypically developing children in the literature. The original form of the scale (SEQv1.0) consists of 25 items that measure hyperreactivity and hyporeactivity patterns in social and non-social contexts (8). In a study conducted with 258 children aged 5 to 80 months, including those with pervasive developmental disorders, developmental disorders/intellectual disabilities, other developmental disorders, and typically developing children, the Cronbach's alpha of the original form of the scale was determined to be 0.80. The scale distinguished sensory patterns in young children with ASD from comparison groups such as pervasive developmental disorders, developmental disorders/intellectual disabilities, other developmental disorders, and typically developing children. (8). Additionally, the intraclass correlation coefficient of the original scale was determined to be 0.92 in another study conducted with 358 children aged 5 to 72 months, including those with autism, developmental delay, and typical development (22). In SEQv2.0, 10 more items were added to balance the number of items in the original form of the scale, but no additional psychometric properties for this version have been published. Later, SEQv2.1 was published, which has both a long version (53 items) and a short version (33 items). In these versions of the scale, in addition to hyporeactivity and hyperreactivity, items that measure sensory seeking patterns were included. The Cronbach's alpha of SEQv2.1 for its sub-factors was found to be 0.75 for hyporeactivity, 0.73 for hyperreactivity, and 0.80 for sensory seeking (23). Moreover, a recent study on the short version of SEQv2.1, focusing on three sensory response patterns, validated these patterns in a large community sample of 2.205 typically developing children aged 36 to 47 months, similar to previous studies with clinical populations (9). Finally, SEQv3.0 was developed, consisting of a total of 105 items aimed at measuring enhanced perception in addition to the previous three sensory response patterns. The conceptual model of SEQv3.0 with four different sensory patterns was validated through a confirmatory factor analysis model in a study conducted with 1.407 children with ASD aged 24 to 144 months (7). In the Polish version of SEQv3.0, conducted with 208 children with ASD aged 36 to 84 months, the four-factor structure was also validated, but it was reported that the factor loadings of many items related to sensory seeking and enhanced perception were not at acceptable levels (24).

In summary, in recent years, the number of studies focusing on measuring and examining the sensory characteristics of children with ASD in the international literature has been steadily increasing. However, it has been observed that there is a significant gap in this area in our country. This gap may be due to the fact that there is currently no assessment tool available in our country to evaluate sensory characteristics. From this perspective, the aim of this study is to examine the validity and reliability of the Turkish version of the Sensory Experience Questionnaire Short Version-SEQv2.1, based on parent or primary caregiver reports, for measuring the three sensory response models (hyporeactivity, hyperreactivity, and sensory seeking) previously validated in different groups, specifically for young children with ASD.

METHOD

Participants

The participants of the study consisted of 180 children with a diagnosis of ASD, including 136 boys and 44 girls, aged between 24 and 80 months ($\bar{x}$=52.66, *SD*=14, 61), who were receiving education in schools and institutions affiliated with the Ministry of National Education (MoNE). Criterion sampling was used to select the participants. Accordingly, three criteria were required for the children to participate in the study: (a) being in early childhood, (b) not having any secondary disabilities (e.g. visual or hearing impairments), and (c) having their ASD diagnosis confirmed by the Childhood Autism Rating Scale (CARS). Data on the sensory characteristics of 180 children whose parents met these three criteria and volunteered to participate in the study were collected. Additionally, to examine the scale's construct validity in terms of differentiating between different clinical groups, data were collected from the parents of a total of 65 typically developing children, including 36 boys and 29 girls, aged between 24 and 80 months ($\bar{x}$=46.95, *SD*=16.42). All the parents from whom data were collected were mothers.

Data Collection Tools

Childhood Autism Rating Scale (CARS)

It is an observational rating scale developed to distinguish children with

ASD from children with other developmental delays and to measure the severity of most autism-related symptoms (25). The scale consists of 15 items associated with ASD. Each item is rated on a scale from 1 (age-appropriate behavior) to 4 (severe deviation for age) in increments of 0.5 points. The internal consistency (Cronbach's alpha) of the original form of the scale was determined to be 0.94, and the inter-rater reliability coefficient was 0.71. As an indicator of the scale's validity, the correlation between the scale scores and clinicians' ratings was found to be r=0.84, p<0.001. Additionally, as an extra evaluation of the scale's validity, the total score was correlated with independent clinical assessments made by a child psychiatrist and a child psychologist, yielding a correlation of r=0.80, p<0.001.

In this study, the Turkish version of the CARS was used to confirm the autism diagnoses that the participant children had received from the child psychiatry departments of university hospitals, and to examine concurrent criterion validity (26). The psychometric properties of the Turkish version of the scale were found to have internal consistency (α=0, 95), test-retest reliability (r=0.98, p<0, 01), and inter-rater reliability (r=0.97, p<0, 01). Results from principal components analysis and correlations with similar scales (r=0.87, p<0.001 for the Clinical Global Impressions-Severity Scale and r=0.57, p<0.01 for the Autism Behavior Checklist) indicate that the Turkish form of the scale is reliable and valid in identifying autism symptoms and severity. A cut-off score of 29.5 was determined and is accepted as the diagnostic criterion for autism.

Sensory Experience Questionnaire (SEQv2.1)

Developed by Grace T. Baranek et al. and formerly known as the "Sensory Supplement Questionnaire (SSQ)," the Sensory Experiences Questionnaire (SEQ) provides a comprehensive assessment of a child's behavioral responses to a variety of sensory stimuli encountered in daily activities and routines. The SEQ consists of 33 Likert-scale items that examine the sensory characteristics of young children, aged 2–12, with ASD and other developmental disabilities. The items focus on three patterns of behavioural responses that occur in social and non-social contexts: Hyporeactivity (6 items), Hyperreactivity (14 items), and Sensory Seeking (13 items). Additionally, the items are grouped into five sensory categories: Auditory, Tactile, Visual, Vestibular/Proprioceptive, and Gustatory/Olfactory. All items are rated on a 5-point scale ranging from "1- Almost never, 2- Once in a While, 3- Sometimes, 4- Frequently, and 5- Almost always." The scale can be completed in approximately 10 minutes (8).

Translation Process

Before starting the validity and reliability study of the Turkish version of the scale, the necessary permissions were obtained via email from Grace T. Baranek, who led the team that developed the scale. The translation of the scale into Turkish was then carried out by the researchers. This translation was reviewed by a professional translator experienced in academic translations and was back-translated into English. The back-translated version was compared to the original by Grace T. Baranek, and feedback was received regarding the reflection of the intended characteristics of the items and their clarity. The revisions suggested by Grace T. Baranek were first reviewed by the researchers, then sent to another professional translator working in academic translations to review the changes. The form, translated from Turkish to English, was then sent to Grace T. Baranek for a second comparison with the original version, and final approval for the scale was obtained via email.

Data Collection Process

Before beginning the data collection process, approval was obtained from the Ethics Committee of the Educational Sciences Unit at Atatürk University (Date: 23.09.2021; Number: E-56785782-050.02.04-2100255170). Afterwards, private special education institutions affiliated with the Ministry of National Education in the provinces of Erzurum and Ankara were contacted by phone, the purpose of the study was explained, and permission to collect data was requested. In the institutions where permission was granted, data collection began with children and parents who met the study's criteria. During the data collection process, the researchers first explained the purpose of the study to the children's mothers and asked those who volunteered to participate to complete the SEQv2.1. The mothers first filled out the information on the first page of the form (date, child's date of birth, child's gender, person completing the form), then rated the questions on a scale. During this process, the researchers clarified any questions the mothers had without providing any guidance. The researchers met face-to-face with practitioners who knew the children very well (having worked with them for at least six months) to complete the CARS. The necessary explanations on how to complete the scale were given to the practitioners, and the scales were collected on the same day after being filled out by the practitioners.

Data Analysis

During the data analysis phase, the CARS scores of the participating children were first examined, and it was determined that each child scored 30 or above. Then, missing data, outliers, and descriptive statistics for the total scores and factor scores obtained from the SEQv2.1 were reviewed. As a result, four children were excluded from the dataset due to outlier SEQ scores, and eight were excluded due to incomplete scale responses, leaving a total of 180 children for analysis. For the study's objective, the validity of the SEQv2.1 was assessed through construct and criterion validity, and its reliability was examined using internal consistency reliability coefficients. To construct validity, a Confirmatory Factor Analysis (CFA) was first conducted using LISREL (27) based on the forms completed by the mothers. Three factors representing sensory response patterns (hyporeactivity, hyperreactivity, and sensory seeking) were tested using 33 of the 37 quantitative items (excluding 4 control items). Second, the relationships between the sub-factors of the SEQv2.1 and the total score were tested using Pearson correlation analysis. Third, the mean scores obtained from the sub-factors and the total score of the SEQv2.1 by the ASD and typically developing groups were compared using an independent samples t-test to determine statistical significance. For concurrent criterion validity, the relationships between the sub-factors and total score of the SEQ and the CARS were examined using Pearson correlation analysis. Finally, for reliability, the internal consistency of the SEQv2.1 was calculated for the sub-factors and the entire scale using Cronbach's alpha and McDonald's omega reliability coefficients. Except for the CFA, all analyses were performed using the IBM Statistical Package for Social Sciences (SPSS) program version (Statistical Package for the Social Sciences) version 26 software package. To calculate McDonald's omega values for reliability, the McDonald's omega extension for IBM Statistical Package for Social Sciences (SPSS) program version developed by Hayes was used (28).

RESULTS

Descriptive Analysis Results

In the study, the descriptive statistics of the SEQv2.1 and CARS scores in children with ASD were first examined. The results of the descriptive statistics are presented in Table 1.

In Table 1, it can be seen that the kurtosis and skewness coefficients of the SEQv2.1 sub-factor and total scores fall within the ±1 range. These findings indicate that the data show a normal distribution (29). Furthermore, it is

observed that all participants' CARS scores are above the cut-off score which is 29.5.

Validity Analyses

Construct validity

As part of the validity analyses for the SEQv2.1, the suitability of the scale's three-factor structure (hyporeactivity, hyperreactivity, and sensory seeking) for Turkish culture was examined using CFA. The analysis results indicated that the three-factor structure of the scale was also confirmed by the scales completed by mothers in Türkiye. The ratio of the chi-square value to the degrees of freedom on the three-factor scale was found to be χ^2=705.63, *df*=453, *p*=0.000, χ^2/df=1, 56. Additionally, the values for other fit indices examined for the model were determined as *RMSEA*=0.051, *NNFI*=0.92, *CFI*=0.93, and *IFI*=0.93. The items and their factor loading values for the sub-factors of the SEQv2.1 from the CFA results are presented in Table 2.

As shown in Table 2, the factor loadings of the items in the hyporeactivity sub-factor range from 0.47 to 0.72, and the *t*-values for all items in this sub-factor are significant. The factor loadings of the items in the hyperreactivity sub-factor range from 0.06 to 0.66, with all items except for item 20 having significant *t*-values. In the sensory seeking sub-factor,

Table 1. Descriptive statistics related to the SEQv2.1 and CARS scores

	n	X (95%CI)	Sd	Min.	Max.	Kurtosis	Skewness
Hyporeactivity	180	13.90 (13.17–14.64)	4.99	6	27	0.427	-0.505
Hyperreactivity	180	36.67 (35.35–37.98)	8.94	15	59	0.134	-0.355
Sensory Seeking	180	36.19 (34.95–37.42)	8.39	14	61	0.319	0.311
SEQ Total Score	180	86.76 (84.08–89.43)	18.18	38	141	0.153	-0.048
CARS	180	37.35 (36.09–38.62)	8.61	30	56.50	0.038	-0.425

CI: confidence interval; SEQ: Sensory Experiences Scale; CARS: Childhood Autism Rating Scale.

Table 2. Item factor loads, R^2, and t values of SEQv2.1

Sub-factors	Items	Factor loads	R^2	t
Hyporeactivity	3	0.63	0.40	8.99
	4	0.54	0.29	7.33
	10	0.54	0.29	7.16
	12	0.70	0.49	10.10
	19	0.47	0.22	6.09
	21	0.72	0.51	10.28
Hyperreactivity	1	0.51	0.26	6.66
	5	0.26	0.06	3.23
	6	0.52	0.27	6.85
	8	0.37	0.14	4.98
	11	0.59	0.34	8.08
	14	0.57	0.33	7.71
	15	0.54	0.30	7.37
	16	0.56	0.31	7.55
	17	0.66	0.44	9.27
	18	0.32	0.10	4.08
	20	0.06	0.00	**0.77**
	22	0.41	0.17	5.26
	29	0.23	0.05	2.90
	38	0.16	0.02	2.01
Sensory Seeking	9	0.60	0.37	8.03
	23	0.40	0.16	4.99
	24	0.36	0.13	4.37
	25	0.51	0.26	6.66
	27	0.46	0.21	5.90
	28	0.31	0.10	3.85
	30	0.50	0.25	6.50
	36A	0.46	0.21	5.60
	36B	0.38	0.14	4.83
	36C	0.21	0.04	2.43
	36D	0.17	0.02	1.99
	36E	0.37	0.14	4.73
	36F	0.51	0.26	6.58

SEQ: sensory experiences scale

Table 3. T-test results for the SEQ sub-factors and total scale scores for the ASD and TD groups

	Group	n	X	Sd	T	df	p	95%CI
Hyporeactivity	ASD	180	13.90	4.99	12.64	239.56	0.000	4.80–6.57
	TD	65	8.22	2.04				
Hyperreactivity	ASD	180	36.67	8.94	5.46	149.08	0.000	3.73–7.96
	TD	65	30.82	6.76				
Sensory Seeking	ASD	180	36.19	8.39	2.82	243	0.005	1.05–5.91
	TD	65	32.71	8.92				
SEQ Total Score	ASD	180	86.76	18.18	6.79	145.31	0.000	10.64–19.38
	TD	65	71.45	14.09				

ASD: autism spectrum disorder; TD: typically developing; CI: confidence interval; SEQ: Sensory Experiences Scale

the item factor loadings range from 0.17 to 0.60, and the *t*-values for all items are significant.

To further establish construct validity, the correlation levels between the sub-factors and the total scale score were examined. Hyporeactivity is moderately positively related to hyperreactivity (*r*=0.528, *p*=0, 000), hyporeactivity is also moderately positively related to sensory seeking (*r*=0.359, *p*=0, 000), and hyperreactivity is moderately positively related to sensory seeking (*r*=0.520, *p*=0, 000). Additionally, hyporeactivity, hyperreactivity, and sensory seeking sub-factors have a high positive relationship with the total scale score (*r*=0.700, *p*=0.000; *r*=0.877, *p*=0.000; *r*=0.816, *p*=0.000, respectively).

Finally, the ability of the SEQv2.1 to distinguish between the two groups, typically developing and ASD, was investigated for construct validity. The results of the independent samples t-test conducted for this purpose are presented in Table 3. As shown in Table 3, the average scores obtained by the ASD group for the sub-factors and the total scale are significantly higher than those of the typically developing group.

Criterion Validity

For the criterion validity of the SEQv2.1 in children with ASD, the relationships between the sub-factors and total scale score and the CARS score were examined. As a result of the correlation analyses, it was found that there were moderately positive significant relationships between the score of the CARS and hyporeactivity (*r*=0.41, *p*=0, 000), hyperreactivity (*r*=0.30, *p*=0, 000), sensory seeking (*r*=0.32, *p*=0.000), and the total scale score (*r*=0.40, p=0, 000).

Reliability Analyses

Internal Consistency Coefficients

To examine the reliability of the SEQ, Cronbach's alpha internal consistency and McDonald's omega coefficients were analyzed. As a result of the analyses, the Cronbach's alpha coefficients were found to be 0.767 (*95% CI*=0.704–0.817) for hyporeactivity, 0.755 (*95% CI*=0.697–0.798) for hyperreactivity, 0.751 (*95% CI*=0.665–0.812) for sensory seeking, and finally 0.861 (*95% CI*=0.822–0.891) for the total scale. The McDonald's omega coefficients were found to be 0.771 (*95% CI*=0.701–0.818) for hyporeactivity, 0.739 (*95% CI*=0.657–0.797) for hyperreactivity, 0.733 (*95% CI*=0.616–0.799) for sensory seeking, and finally 0.850 (*95% CI*=0.804–0.885) for the total scale.

DISCUSSION

The aim of this study is to examine the psychometric properties of the short version of the SEQ, which consists of three sensory response patterns (hyporeactivity, hyperreactivity, and sensory seeking), in children with ASD in the younger age group. The findings provide generally satisfactory psychometric properties for the Turkish version of the scale, indicating that it is a valid and reliable tool.

The results of the CFA conducted to investigate construct validity confirmed the three-factor structure of the scale. The indices considered for evaluating the model fit, such as *RMSEA* (>0.05), *NNFI* (≥0.90), *CFI* (≥0.90), and *IFI* (≥0.90), indicated that the model demonstrated an acceptable fit (30). These findings validate that the three sensory response patterns previously found in different samples (9) are also present in children with ASD in the younger age group.

When the factor loadings and *t* values for each item in the model are examined, the factor loadings of the items in the hyporeactivity sub-factor (>0, 30) are acceptable (31) and all *t* values are significant. The factor loadings of the items in the hyperreactivity and sensory seeking sub-factors range over a wider range than the items in the hyporeactivity sub-factor. However, despite the acceptable fit indices, the factor loadings of some items in the hyperreactive (5,20,29 and 38) and sensory seeking (36C and 36 D) sub-factors were lower than the generally accepted value (<0, 30), but the t values of all items except item 20 were significant. When the items with low item loadings were removed from the model, the model fit indices did not improve, and Cronbach's alpha (hyperreactivity=0.777, sensory seeking=0.746, total scale=0.872) and McDonald's omega (hyperreactivity=0.781, sensory seeking=0.742, total scale=0.873) values decreased or improved slightly. Therefore, it was decided to preserve all 33 items used in the original version of the SEQv2.1 scale in the Turkish version in order not to disturb the measured structure by taking expert opinions (32). However, the low loadings of these items in the hyperreactivity and sensory seeking factors indicate that these items are present in the relevant factors with much less certainty (24). Considering the previous studies conducted with larger samples and a wider age range (7,8,9,23,24), it was thought that this may be related to the sample size and/or the younger age of the participants. It was also considered that the finding related to item 20 (Does your child dislike being tickled?) may be related to the age and number of participants as well as cultural characteristics. In a study conducted with a large sample of young children with typically developing, item 20 had a lower loading factor than the items in the hyperreactivity factor (9). More clearly, in Turkish culture, 'tickling' in the young age group is generally characterised as a play. That suggests that different caregiving experiences, perceptions and expectations may have an effect on this finding (9).

To determine the construct validity of the SEQv2.1 scale, relationships between the sub-factors and the overall scale score were examined alongside the CFA, and the sub-factors were moderately positively related

to each other. These moderate positive relationships between sensory response patterns are consistent with literature indicating that these sensory response patterns are related to each other (7,9). The findings suggest that the measurements included in the scale provide information about different sensory response patterns while also measuring the same underlying structure. Additionally, the correlations between sensory patterns are consistent with literature stating that sensory patterns often coexist in children with ASD (8).

Finally, to assess the construct validity of SEQv2.1, the scores obtained from sub-factors and the total scale for children with ASD and typically developing children were examined to see if they differed. The results showed that the scores obtained by children with ASD were significantly higher than those of typically developing children. That supports previous findings (8) that SEQv2.1 can distinguish between the sensory patterns of young children with ASD and those of typically developing children.

To examine the concurrent criterion validity of SEQv2.1, the relationships between the sub-factors and the total scale score with CARS were analyzed, revealing moderate positive relationships. These findings provide data regarding the criterion validity of the sensory response patterns included in SEQv2.1.

The analysis results related to the reliability of SEQv2.1 indicated that the Cronbach alpha values for sensory response patterns and the total score were above 0.75, while the McDonald's omega values were above 0.70, and the relationships between items and total scores were significant. These values suggest that the sub-factors are acceptable (>0, 70) and the overall scale has good (>0, 80) internal consistency (31). The findings regarding reliability are also supported by existing research (23).

In conclusion, this study determined that the Turkish version of SEQv2.1 is a generally valid and reliable tool for measuring the sensory characteristics of young children with ASD. The validity and reliability study of the Turkish form of SEQv2.1, which is widely used in international literature, is expected to contribute to a) the identification process of children at risk for ASD, b) characterizing a range of sensory characteristics of children with ASD, c) identifying children with significant sensory characteristics that require more detailed assessment and intervention, and d) monitoring changes in the severity of sensory characteristics as a result of maturation or intervention among diagnosticians and practitioners in our country. Furthermore, future researchers using this scale will provide international findings related to sensory characteristics in the literature.

In addition to significant contributions to the field, the study has some limitations. First, the study recruited a number of participants that is at least five times the number of items on the scale, as generally recommended in the literature (33). However, the low factor loadings in some items may be related to the small number of participants and/or the young age of the participants, due to the fact that sensory response patterns may differentiate with age. Secondly, the validity and reliability of the scale were only examined in young children with ASD in this study. However, sensory characteristics are also known to be present in typically developing children and children with other developmental disabilities. Therefore, it is suggested that the psychometric properties of the Turkish version of this scale be examined in larger samples, across different age groups, and in various clinical groups.

Ethics Committee Approval: Before beginning the data collection process, approval was obtained from the Ethics Committee of the Educational Sciences Unit at Atatürk University (Date: 23.09.2021; Number: E-56785782-050.02.04-2100255170).

Informed Consent: The participating parents and practitioners were informed about the purpose of the study and the principles of confidentiality; their voluntary consent for the use of data for scientific purposes was obtained.

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