Brief Report

# Reliability and Validity of the Korean Child Sensory Profile–2

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**Importance:** The Korean Child Sensory Profile–2 (K-CSP–2) is a tool for assessing sensory processing that was recently culturally adapted for use with Korean children.

**Objective:** To investigate the test–retest and interrater reliability and the convergent and discriminant validity of the K-CSP–2.

**Design:** Cross-sectional study.

**Setting:** Community settings in South Korea.

**Participants:** Caregivers of 102 children with autism spectrum disorder (ASD) and 156 typically developing (TD) children ages 3–14 yr.

**Outcomes and Measures:** The K-CSP–2 was tested for reliability and validity using the Korean version of the Sensory Profile (K-SP) and the Korean Behavior Assessment System for Children–2 (K-BASC–2).

**Results:** The K-CSP–2 demonstrated good test–retest and interrater reliability. The K-CSP–2 was correlated with the K-SP and the K-BASC–2. Children with ASD had higher K-CSP–2 scores than TD children. The discriminant analysis classified children with ASD and TD children with an overall accuracy of 89%.

**Conclusions and Relevance:** The K-CSP–2 can be used to assess the sensory processing of Korean children consistently across time and raters. The instrument maintains the quadrant factors of the K-SP and relates to adaptive and maladaptive behaviors. The K-CSP–2 can distinguish children with ASD from TD children.

**What This Article Adds:** Korean occupational therapy practitioners can use the K-CSP–2 to identify sensory processing patterns and to support the evaluation of children with ASD.

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Sensory processing can support or interfere with occupations in everyday life. Children who have difficulties with sensory processing may encounter challenges while performing daily life activities. In particular, children with autism spectrum disorder (ASD) are more likely to have problems associated with sensory processing than typically developing (TD) children (Ismael et al., 2018).

Sensory processing in both children with ASD and TD children can be understood using Dunn's (1997) sensory processing framework. Dunn (1999) developed the Sensory Profile (SP) on the basis of this framework and later the Child Sensory Profile–2 (CSP–2; Dunn, 2014). The Korean Child Sensory Profile–2 (K-CSP–2; Kim et al., 2021), the Korean standardized version of the CSP–2, was recently published.

Evidence suggests that the reactivity of Korean children to their environment may differ from that of U.S. children (Chen, 2018). For example, Korean children tend to have more inhibited behavior than U.S. children. Therefore, a psychometric study in Korea was required to establish whether the K-CSP–2, culturally adapted from the U.S. version of the CSP–2, is suitable for measuring sensory processing in Korean children. The standardization sample for the K-CSP–2 showed internal consistency and factorial structure (Kim et al., 2021) consistent with those of the CSP–2 in U.S. children (Dean et al., 2016; Dunn, 2014).

In this study, we aimed to further establish the psychometric properties of the K-CSP–2. We first investigated test–retest and interrater reliability to identify consistency across time and raters. We then examined convergent and discriminant validity. We

evaluated the convergent validity of the K-CSP–2 using the Korean version of the Sensory Profile (K-SP; Lim et al., 2007) and the Korean Behavior Assessment System for Children–2 (K-BASC–2; Ahn, 2018). We analyzed the correlations in each quadrant (seeking, avoiding, sensitivity, and registration) between the K-CSP–2 and the K-SP to determine whether the construct based on Dunn's sensory processing framework was maintained across the first and revised versions. Because sensory processing is related to challenging behavior and adaptability in U.S. children (Dunn, 2014), we investigated the relationship between sensory processing measured by the K-CSP–2 and behaviors assessed using the K-BASC–2. Because atypical sensory processing is prevalent in children with ASD (Tomchek & Dunn, 2007), we compared the K-CSP–2 scores of children with ASD with those of TD children and calculated the discriminant function for the K-CSP–2 quadrants to classify children with ASD and TD children.

# Method

## Participants and Procedure

The participants were caregivers of children ages 3–14 yr in South Korea. Caregivers of 156 TD children and 102 children with ASD were recruited via convenience sampling at two preschools, one elementary school, and two child development centers in the communities of Chungcheong Province and Seoul. We also posted a notice on an online mothers' community. All caregivers provided written informed consent. This cross-sectional study was part of the Korean Sensory Profile–2 project approved by the institutional review board of Soonchunhyang University.

The procedures were administered by the first author (Seulkee Kim) with 11 yr of pediatric occupational therapy practice experience. Informed consent forms, instructions for completing questionnaires with phone numbers of researchers (Seulkee Kim and Eun Young Kim), and questionnaires were sent on paper to 154 caregivers through teachers, the postal service, and acquaintances. Eleven other caregivers completed the forms in Seulkee Kim's presence. Ninety-three additional caregivers completed the forms online (SurveyMonkey, San Mateo, CA) through the URL on the recruitment notices posted in the online mothers' community.

## Measures

### *Korean Child Sensory Profile–2*

The K-CSP–2 (Kim et al., 2021) is the Korean version of the CSP–2 (Dunn, 2014). The CSP–2 was designed to assess sensory processing patterns in children ages 3–14 yr using a caregiver questionnaire with 86 items. Like the CSP–2, the K-CSP–2 has quadrants, six sensory sections, and three behavioral sections. A high score indicates a high frequency of item behaviors. The reliability and validity in the standardization sample for the K-CSP–2 have been reported (Kim et al., 2021). Cronbach's alpha coefficients for the K-CSP–2 are >.80, except for the visual processing section ($\alpha = .66$). The four-factor model of the K-CSP–2 showed a good fit, with a root mean square error of approximation of .077.

### *Korean Version of the Sensory Profile*

The SP (Dunn, 1999) measures sensory processing ability in children ages 3–10 yr using a caregiver questionnaire with 125 items. A low score indicates a high frequency of item behaviors, the reverse of CSP–2 scoring. SP scores are categorized into quadrants and 14 sections (Dunn, 2006). We used the K-SP, which has established content validity (Lim et al., 2007).

### *Korean Behavior Assessment System for Children–2*

The K-BASC–2 (Ahn, 2018) is the Korean version of the Behavior Assessment System for Children—Second Edition (BASC–2; Kamphaus & Reynolds, 2007), which was designed to comprehensively measure adaptive and maladaptive behaviors. We used the 134-item Parent Rating Scale–Preschool (PRS–P) for preschoolers ages 3–5 yr and the 160-item Parent Rating Scale–Child (PRS–C) for children ages 6–11 yr. For the analysis, we used the Behavioral Symptoms Index and the Adaptive Skills Composite scores.

## Data Analysis

To determine the test–retest and interrater reliability of the K-CSP–2, we used the intraclass correlation coefficient (ICC). To assess convergent validity, we calculated Pearson's correlation coefficients to compare the K-CSP–2 scores to both the K-SP and K-BASC–2 scores. To assess discriminant validity, we compared 102 children with ASD to 102 TD children using multivariate analysis of variance. Next, we conducted discriminant analysis with ASD diagnosis as the dependent variable and the K-CSP–2 quadrants as predictor variables. All data were analyzed using IBM SPSS Statistics (Version 22). The $\alpha$ level was set at .05 in the two-tailed test.

# Results

## Test–Retest Reliability

Table 1 shows reliability and validity data for the K-CSP–2. Test–retest reliability was obtained in a subset of 107 TD children ($M$ age = 6.5 yr, $SD$ = 2.6; 55 boys) at an interval ranging from 7 to 35 days ($M$ = 12.5, $SD$ = 5.2). ICCs were in the good range for the quadrants, sensory sections, and behavioral sections (.75–.90).

## Interrater Reliability

Interrater reliability was determined using data from 49 pairs of caregivers of TD children ($M$ age = 7.6 yr,

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**Table 1.** Test–Retest Reliability, Interrater Reliability, Convergent Validity, and Discriminant Validity of the Korean Child Sensory Profile–2 ($N = 258$)

| | Reliability, ICC | | Convergent Validity With the K-BASC–2, *r* | | | | Discriminant Validity | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | PRS–P | | PRS–C | | | | | |
| Item | Test–Retest | Interrater | Behavioral Symptoms Index | Adaptive Skills Composite | Behavioral Symptoms Index | Adaptive Skills Composite | ASD Group, *M* (*SD*) | TD Group, *M* (*SD*) | *F* | $\eta_p^2$ |
| Quadrants | | | | | | | | | | |
| Seeking | .87*** | .82*** | .65*** | −.26 | .41** | −.20 | 44.28 (16.08) | 29.57 (9.16) | 64.50*** | .24 |
| Avoiding | .90*** | .79*** | .57*** | −.27 | .41** | −.31* | 55.21 (16.00) | 29.83 (7.79) | 207.33*** | .51 |
| Sensitivity | .86*** | .79*** | .70*** | −.38** | .50*** | −.34* | 48.32 (14.26) | 26.53 (7.21) | 189.71*** | .48 |
| Registration | .80*** | .75*** | .71*** | −.33* | .54*** | −.26 | 50.52 (17.40) | 27.38 (6.20) | 160.04*** | .44 |
| Sensory sections | | | | | | | | | | |
| Auditory | .81*** | .63*** | .37** | −.19 | .27* | −.32* | 21.22 (7.35) | 12.80 (4.15) | 101.45*** | .33 |
| Visual | .75*** | .77*** | .38** | −.10 | .16 | −.13 | 11.00 (4.94) | 10.21 (3.48) | 1.76 | .01 |
| Touch | .75*** | .51*** | .54*** | −.36** | .51*** | −.23 | 21.53 (9.56) | 13.91 (3.55) | 56.89*** | .22 |
| Movement | .80*** | .86*** | .53*** | −.15 | .33* | −.23 | 17.86 (7.12) | 11.57 (3.59) | 63.52*** | .24 |
| Body position | .75*** | .73*** | .58*** | −.23 | .35** | −.19 | 17.16 (8.23) | 9.79 (2.84) | 72.94*** | .27 |
| Oral | .89*** | .75*** | .56*** | −.30* | .37** | −.14 | 25.33 (10.58) | 15.31 (5.97) | 69.41*** | .26 |
| Behavioral sections | | | | | | | | | | |
| Conduct | .89*** | .82*** | .50*** | −.12 | .41** | −.34* | 23.42 (7.70) | 14.09 (4.97) | 105.71*** | .34 |
| Social emotional | .89*** | .67*** | .53*** | −.22 | .39** | −.23 | 43.54 (12.63) | 20.32 (5.98) | 281.68*** | .58 |
| Attentional | .77*** | .71*** | .61*** | −.34* | .49*** | −.21 | 23.78 (8.01) | 11.95 (2.58) | 201.53*** | .50 |

*Note.* ASD = autism spectrum disorder; ICC = intraclass correlation coefficient; K-BASC–2 = Korean Behavior Assessment System for Children–2; PRS–C = Parent Rating Scale–Child; PRS–P = Parent Rating Scale–Preschool; TD = typically developing.
*$p < .05$. **$p < .01$. ***$p < .001$.



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*SD* = 3.2; 30 boys). Most caregiver pairs were a mother and a father, except for one mother–grandmother pair. ICCs were good for the quadrants (.75–.82) and moderate to good for the sensory and behavioral sections (.51–.86).

### Convergent Validity

We performed the correlation analysis between the K-CSP–2 and the K-SP with 91 TD children (*M* age = 5.8 yr, *SD* = 1.9; 48 boys). The K-CSP–2 quadrants were strongly correlated with those of the K-SP (seeking, $r = -.83$, $p < .001$; avoiding, $r = -.81$, $p < .001$; sensitivity, $r = -.83$, $p < .001$; registration, $r = -.77$, $p < .001$).

For the correlation analysis between the K-CSP–2 and the K-BASC–2, 53 TD preschoolers were included for the PRS–P scale (*M* age = 4.4 yr, *SD* = 0.8; 31 boys) and 54 TD children for the PRS–C scale (*M* age = 8.7 yr, *SD* = 2.0; 24 boys). K-CSP–2 scores were positively correlated with the Behavioral Symptoms Index of the K-BASC–2 and negatively correlated with the Adaptive Skills Composite (see Table 1). K-CSP–2 scores correlated with PRS–C scores to a lesser degree than with PRS–P scores. The highest correlation coefficient was found between registration and the Behavioral Symptoms Index.

### Discriminant Validity

We compared the K-CSP–2 scores of 102 children with ASD (*M* age = 7.8 yr, *SD* = 2.9; 85 boys) to those of 102 age- and sex-matched TD children (*M* age = 7.5 yr, *SD* = 3.2; 85 boys). The scores of children with ASD were significantly higher than those of TD children (*p*s < .001), except for the visual section ($p = .19$).

For the discriminant analysis, we used ASD diagnosis as the dependent variable and the K-CSP–2 quadrants as predictor variables. A single discriminant function was calculated, and the value was significantly different for children with ASD and TD children ($\chi^2 = 160.09$, $p < .001$). The standardized discriminant function coefficients were .56 for avoiding, −.33 for seeking, .47 for sensitivity, and .30 for registration. Avoiding was a significant discriminator (>.50; Ermer & Dunn, 1998). The discriminant function successfully classified 182 of 204 children (89.2%). Eighty-three of 102 children with ASD (81.4%) and 99 of 102 TD children (97.1%) were classified correctly.

## Discussion

Our results show that the K-CSP–2 has good test–retest reliability (.75–.90), comparable to that of the CSP–2 (.87–.97; Dunn, 2014). We also found good interrater reliability (.51–.86), similar to that of the CSP–2 (.49–.89). These reliability results support use of the K-CSP–2 as a tool to stably measure Korean children's sensory processing.

Regarding convergent validity, the K-CSP–2 quadrants showed strong correlations with those of the K-SP (−.77 to −.83), comparable to correlations between the CSP–2 and the SP (−.83 to −.87; Dunn, 2014). These results indicate that constructs based on Dunn's sensory processing framework were maintained from the K-SP to the K-CSP–2.

Further evidence of convergent validity is the correlation between K-CSP–2 and K-BASC–2 scores. Children who showed the behaviors described in the K-CSP–2 more frequently had more maladaptive and fewer adaptive behaviors. The correlation between K-CSP–2 and K-BASC–2 scores in Korean children ages 6–11 was weaker than the correlation between CSP–2 and BASC–2 scores in U.S. children of similar age (Dunn, 2014). The highest correlation between sensory processing and clinical behavior differed by culture; the quadrant most highly correlated with K-BASC–2 scores was registration (high threshold, passive strategy) for Korean children and avoiding (low threshold, active strategy) in U.S. children. This result suggests that the prominent sensory processing components associated with positive and negative behaviors may vary across cultures.

The current study expands previous findings by including K-BASC–2 scores for preschoolers ages 3–5 yr. The correlation between K-CSP–2 scores and the Behavioral Symptoms Index of the K-BASC–2 was higher in preschoolers than in older children, suggesting that the younger the child, the greater the relationship between sensory processing and challenging behaviors.

Our findings also demonstrate that children with ASD engaged more frequently in behaviors assessed by the K-CSP–2 than TD children, consistent with the findings of previous studies (Chojnicka & Pisula, 2019; Dunn, 2014). The discriminant analysis with quadrants as predictors successfully distinguished children with ASD from TD children (overall accuracy, 89.2%; sensitivity, 81.4%; specificity, 97.1%), consistent with Ermer and Dunn (1998), whose analysis based on the SP correctly classified 89.1% of the total sample (78.9% of children with ASD, 76.7% of children with attention deficit hyperactivity disorder, and 90.8% of children without disabilities). Our findings, like those of previous studies, show that factors based on Dunn's theoretical framework can successfully distinguish between children with and without disabilities.

## Limitations and Future Research

This study has several limitations. First, we assumed, but did not verify, that the caregivers reported accurate demographic information. Second, the average test–retest reliability interval was shorter than the recommended 2-wk period (Streiner et al., 2015). Third, test–retest and interrater reliability and convergent validity were tested only in TD children. Future studies should investigate psychometric properties in children with disabilities (Little et al., 2011) and verify

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caregiver reports using the suggested procedure (Streiner et al., 2015).

## Implications for Occupational Therapy Practice

The results of this study have the following implications for occupational therapy practice:

- The results offer further evidence that the K-CSP–2 has good reliability and validity in assessing sensory processing in Korean children.
- The accuracy of classification of children with ASD and TD children suggests that the K-CSP–2 can be useful in diagnosing ASD.

## Conclusion

The K-CSP–2 can assess the sensory processing of Korean children consistently across time and raters. The K-CSP–2 quadrant factors are similar to those of the K-SP and measure sensory processing aspects related to adaptive and maladaptive behaviors. In addition, the K-CSP–2 can successfully classify children with ASD and TD children. The psychometric properties of the K-CSP–2 are comparable to those of the CSP–2, suggesting that the CSP–2 has constructs appropriate for cross-cultural use.

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