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Norm and Standardization Study for Naglieri Nonverbal Ability Test, 5-9 Age Group

ABSTRACT

Background: The aim of the present study was to test the Naglieri Nonverbal Ability Test for children in the 5-9 age group and to determine the psychometric attributes of this tool. Intelligence is a complex and abstract concept. Therefore, it is not possible to observe or measure directly. However, it helps experts to have an idea about the intelligence levels of people with the evaluation scales used. Nonverbal ability tests are also one of the assessment scale types used for this purpose.

Method: The study was conducted based on the general survey model. One district from each socioeconomic development region was selected via random assignment taking as a basis the socioeconomic development listing for the districts. The study was carried out with 753 children from 4 different socioeconomic development regions. Naglieri Nonverbal Ability Test, Test of Nonverbal Intelligence-3, Colored Progressive Matrices Test, and Denver II Developmental Screening Test were used for data collection. Cronbach Alpha reliability, test-retest reliability, and parallel form reliability were calculated during Naglieri Nonverbal Ability Test reliability analyses. For validity analysis, the level of correlation between Naglieri Nonverbal Ability Test and Test of Nonverbal Intelligence-3 and Colored Progressive Matrices Test tests was examined.

Results: It was determined that Naglieri Nonverbal Ability Test has high reliability with an average reliability coefficient of .88. High correlation was observed between the A and B forms of Naglieri Nonverbal Ability Test A ($r = 0.93$, $P < .001$) and during the test-retest analyses (0.87, 0.88). A statistically significant difference was determined between the Naglieri Nonverbal Ability Test scores and class level and age group, while a statistically significant difference could not be determined based on gender. A high, positive, and statistically significant correlation was determined between Naglieri Nonverbal Ability Test and Colored Progressive Matrices Test ($r = 0.84$, $P < .001$), whereas a moderate, positive, and statistically significant correlation was determined between Naglieri Nonverbal Ability Test and Test of Nonverbal Intelligence-3 ($r = 0.52$, $P < .001$).

Conclusion: The findings illustrate that Naglieri Nonverbal Ability Test is a valid and reliable intelligence test for measuring general intellectual ability and for assessing reasoning skills.

Keywords: Intelligence Test, Psychometrics, Validation Study

Introduction

Today, the cognitive functions of individuals are verbally measured in the majority of the intelligence tests used in the world and in our country which may lead to significant disadvantages for conditions when the linguistic functions of the individuals and the spoken language are insufficient. McCallum, (2003) emphasizes that conducting assessments via tests including verbal instructions is not optimal and indeed ethical for many individuals.[1] It is indicated that in some cases language acts not as a window to intelligence but as an obstacle as is the case for individuals in many minority groups. In the meantime, even though it is possible to translate tests with verbal instructions into other languages, this process is both costly and time consuming. Moreover, minor differences due to dialects of the same language may also lead to translation issues. It can be indicated when such factors are taken into consideration that the primary

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alternative to testing the children in their native tongues is eliminating language as a variable and preferring to use nonverbal tests.[2] The term "nonverbal test" is used not because of the cognitive processes that the participants use for solving the test items but because of the method of implementing the test items. "Nonverbal items" widely require verbal or mathematical knowledge or utilize tasks that greatly simplify the solution by way of verbal or mathematical cognitive processes.[3] Nonverbal intelligence tests aim to measure the general cognitive abilities of individuals independent of verbal and linguistic ability levels with the least impact from culture. The following nonverbal intelligence tests are widely used today; Universal Nonverbal Ability Test, Raven Standard Progressive Matrices (RSPM), Naglieri Nonverbal Ability Test (NNAT-I), Nonverbal Ability Test (TONI-3, TONI-4).[4] The general content of these tests has common attributes such as rapidly measuring nonverbal abilities, numerical abilities, abstract reasoning, and general problem-solving.[5] Such ability tests combined with minimum motor requirements enable the fair assessment of the measuring level independent of the measurement of verbal, mathematics, and reading abilities. These tests can be easily applied on children of different genders, ethnic origins, and socioeconomic structures because they are not dramatically affected by culture and language.[6–8] They can also be used for the assessment of the cognitive abilities of individuals from populations in culturally and linguistically diverse regions and especially with different languages and cultures, the assessment of individuals with hearing impairment, the assessment of illiterate or semi-literate individuals with social and economic disadvantages, the assessment of individuals with language and speaking impairments as well as the assessment of individuals with mental deficiency.[9]

It was aimed within the scope of the study to test the NNAT-I developed by Jack Naglieri for children in the 5-9 age group and to determine the psychometric properties of this tool. It is an ability test with 72 nonverbal items that was used by Jack Naglieri in 2003 for assessing the reasoning abilities of individuals in the 5-17 age group. This test is used in America and many European countries. However, no study has been observed on NNAT-I in Turkey. It is considered that NNAT-I will contribute to the identification of nonverbal cognitive ability, rapid clinical assessment, and individual/group test applications requiring student selection.

Methods

Sample

The population of the study was comprised of 19 797 preschool and 54 826 primary school students in the Aydın province. Whereas a total of 4 districts with 1 district selected via random assignment from each socioeconomic development region based on the Socioeconomic Development Index Ranking of Districts[10] by the State Planning Organization in 2004 made up the sample group. These districts are Efeler, Köşk, Koçarlı, and Karpuzlu. Since correlation analysis-based statistical methods were used in the present study, it was considered that conducting a sample group study 10 times more than the number of items would contribute to acquiring more accurate results.[11] Since the test consisted of 72 items to be applied to participants in the 5-17 age group, the sample group of the study was comprised of 753 children in the 5-9 age group continuing their education at 4 private kindergartens and 6 state primary schools under the Ministry of National Education in 4 districts of the Aydın province the 4 districts of the Aydın province taking into consideration the possible case losses and parametric test criteria.

Participants

It was observed when the sociodemographic characteristics of the participants were examined that a total of 379 (50.3%) girls and 374 (49.7%) boys took part in the study. Of these children, 109 (14.5%) were 5 years old, 128 (17.0%) were 6 years old, 141 (18.4%) were 7 years old, 184 (24.4%) were 8 years old and 191 (25.4%) were 9 years old. Among them, 195 (25.9%) are continuing their education at a Kindergarten, 120 (15.9%) are first grade students, 158 (21%) are second grade students, 151 (20.1%) are third-grade students and 129 (17.1%) are fourth-grade students. Based on the assessment of the development level of the regions where these children are living, it was determined that 329 children (43.7%) are in the first region, 128 (17.0%) are in the second region, 128 (17%) are in the third region and 168 (22.3%) are in the fourth region.

Data Collection Tools

Naglieri Nonverbal Ability Test: It is an ability test comprised of 72 nonverbal items developed by Jack Naglieri in 2003 for the assessment of the reasoning abilities of participants in the 5-17 age group. It was set forth based on the internal consistency reliability analyses for age groups as part of the United States of America standardization for NNAT-I that the Cronbach Alpha internal consistency coefficients for the test were between 0.89 and 0.95. Naglieri Nonverbal Ability Test has a mean reliability coefficient of .91.[9]

Colored Progressive Matrices Test: It is comprised of 36 items. It includes A, AB, and B sets with 12 items in each.[12] The norm and standardization studies for the Colored Progressive Matrices Test in Turkey were conducted by Bildiren (2017) with 433 girls (46.8%) and 492 boys (53.2%) in the 3-9 age sample group adding up to a total of 925 children. It was determined as a result of the study that the test has a Cronbach Alpha coefficient of 0.83 and a Spearman Brown split half test correlation of 0.80.[13]

Test of Nonverbal Intelligence-3**:** It was developed in 1995 with 45 items and which was then classified into 23 age groups with a norm sample in the 6-89 age interval.[6] It was determined as a result of the internal consistency reliability analyses conducted for the United States of America standardization for TONI-3 test that the Cronbach Alpha internal consistency reliability coefficients for the A and B forms of the test were in the 0.89 and 0.97 interval. Turkey adaptation and standardization studies were conducted by Korkmaz, Bildiren, Demiral, and Güngör Çulha (2018) with 631 children in the 6-11 age sample group. Kuder-Richardson -20 internal consistency reliability coefficient was determined in the present study as 0.86-0.95 for the TONI-3 A form and as 0.90-0.93 for the B form.[14]

MAIN POINTS

- *Naglieri Nonverbal Ability Test (NNAT-I) had high reliability with an average reliability coefficient of 0.88.*
- *The correlation coefficient between the total scores for NNAT A Form and B Form was 0.93.*
- *A statistically significant difference was not observed in the NNAT scores based on gender.*
- *The correlation coefficient between the NNAT-I and Colored Progressive Matrices total scores was 0.84.*
- *The correlation coefficient between the NNAT-I and Test of Nonverbal Intelligence-3 total scores was 0.52.*

Denver II Developmental Screening Test: Developed by Frankenburg et al (1992).[15] The Turkish adaptation and standardization study of Denver II Developmental Screening Test for birth to 6 years has been completed by Anlar and Yalaz (1996).[16] This is a screening test used for screening proper development in a child based on milestones according to age which enables the verification of suspicious developmental issues by way of an objective measurement in addition to providing means to monitor the children in the developmental risk group. Denver II Developmental Screening Test is comprised of 22 items in the personal-social domain, 32 items in the fine motor domain, 43 items in the language domain, and 38 items in the gross motor domain making up a total of 116 items in 4 domains.

Data Collection: Study data were collected during February 2021-October 2021. The implementation was conducted individually in 1 session based on the guidelines indicated in the NNAT-I test handbook. The average duration of the test was 15 to 20 minutes. Data collection studies for the test were carried out via Form A. Form B was applied on 43 children with an interval of 1 week to check correlation. Denver II Developmental Screening Test was also applied on the same day to 94 children in the 5-6 age group. In addition, CPM was applied to 66 children in the 5-9 age group within a period of 1 week. TONI-3 test was also applied on 65 children in the 6-9 age group within a period of 1 week. Test-retest application was conducted in 2 different time intervals including a 4-week interval for 88 children and an 8-week interval for 62 children who were previously subject to Naglieri Nonverbal Ability Test.

Statistical Analysis

Statistical Packag for Social Sciences (SPSS) for Windows 22 (22.0. Armonk, NY: IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version) software was used for the statistical analysis of the acquired data. Number and percentage distributions were used during data analysis to determine the descriptive characteristics of the students whereas test-retest reliability (Pearson Product Moments), parallel form reliability (Pearson Product Moments), and Cronbach Alpha reliability based on ages were used to determine the reliability of the measurement tool, *t*-test was used to determine the impacts on gender via NNAT scores and 1-way ANOVA/Scheffe analysis was used to determine the impacts on age via NNAT scores.

For validity analyses; Pearson Products Moment formula was used to calculate the correlation level between the NNAT and the CPM Test and Toni-3 tests that are widely used in international literature. Moreover, Denver II Developmental Screening Test and 1-way ANOVA/Scheffe analysis were conducted for examining the NNAT-I results and the impacts on the development levels of the children. The significance level for Cronbach Alpha, Pearson Product Moments, 1-way ANOVA/Scheffe, and *t*-test analyzes was analyzed as $P < .01$.

Ethical Considerations

Permission was obtained from the scale's developer to conduct a Turkish validity and reliability study via e-mail. Ethics approval was obtained from the Ethics Committee of the Faculty of Health Sciences of Aydın Adnan Menderes University (2020/005). The present study was supported by Aydın Adnan Menderes University Scientific Research Projects Unit with the project number EĞF-21002. Informed consent forms were obtained from all participants and their families. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Results

The aim of the present study was to test the NNAT-I for children in the 5-9 age group and to determine the psychometric characteristics of this tool. Reliability and validity analyses were conducted for this purpose and the acquired data have been presented in the following tables.

Table 1 presents the reliability coefficients calculated based on different age intervals. The standard errors calculated according to the reliability coefficients have also been listed in the same table. It was illustrated that NNAT-I has a high reliability with an average reliability coefficient of 0.88.

The average value for the first application of NNAT was 23.44 (7.39), 4-week application average score was 30.03 (5.92) and the 8-week application average score was 25.43 (8.50). The correlation coefficient between the first application and the test-retest application at the end of 4 weeks was calculated as 0.88. The correlation coefficient between the first application and the test-retest application at the end of 8-weeks was calculated as 0.87 (Table 2). It was observed that the NNAT scores were consistently based on age and time.

It was observed when Table 3 was examined that the NNAT A Form average is 23.44 (7.39) and the B Form average is 25.43 (7.00). The average standard score difference between Forms A and B was calculated as 0.39. A strong, positive, and statistically significant correlation is observed between NNAT A Form and B Form, $r = 0.93$, $P < .001$. The correlation coefficient between the total scores for the 2 forms was determined as 0.93.

It was observed when Table 4 was examined that the NNAT scores did not change at a statistically significant level based on gender, $t\,(751) = 0.98$, $P = .174$.

Table 1. Cronbach Alpha Coefficients Based on Age

Age	n	Cronbach Alpha Coefficient	SE_E
5 years old	109	0.80	5.37
6 years old	128	0.82	5.22
7 years old	141	0.87	4.70
8 years old	184	0.88	4.57
9 years old	191	0.84	5.04
Total	753	0.88	4.57

Standard estimation errors were calculated using the following formula; $SE_E = 15_{xx}(r_{xx})$.

Table 2. Test-retest Reliability

	n	mean (SD)	*r* (*P*)
NNAT-I (First application)		23.44 (7.39)	
ReTest (4 weeks)	88	30.03 (5.92)	0.88 (<.001)
ReTest (8 weeks)	62	25.43 (8.50)	0.87 (<.001)

NNAT-I, Naglieri Nonverbal Ability Test. mean (SD), standard deviation.

Table 3. Parallel Form Reliability

	mean (SD)	*r* (*P*)
NNAT-I (A Form)	23.44 (7.39)	0.93 (<.001)
NNAT-I (B Form)	28.20 (7.00)	

NNAT-I, Naglieri Nonverbal Ability Test. mean (SD), standard deviation.
n = 43.

Table 4. T-test results for NNAT-I scores based on gender

Gender	n	mean (SD)	*df*	*t*	*P*
Girl	379	23.84 (6.31)	751	0.98	.174
Boy	374	23.37 (6.76)			

NNAT-I, Naglieri Nonverbal Ability Test. mean (SD), standard deviation.

Table 5. Descriptive Statistics for NNAT-I Scores Based on Chronological Age

Age	n	mean (SD)
5 years	109	18.64 (4.58)
6 years	128	19.54 (4.57)
7 years	141	23.02 (5.97)
8 years	184	25.76 (6.29)
9 years	191	27.52 (5.80)

NNAT-I, Naglieri Nonverbal Ability Test. mean (SD), standard deviation.

Table 6. NNAT-I and CPM Correlation

	n	mean (SD)	*r* (*P*)
NNAT		23.44 (7.39)	
CPM	66	24.65 (5.99)	0.84 (<.001)
TONI-3	65	21.78 (6.53)	0.52 (<.001)

NNAT-I, Naglieri Nonverbal Ability Test. CPM, Colored Progressive Matrices Test. TONI-3, Test of Nonverbal Intelligence-3. mean (SD), standard deviation.

Table 5 illustrates a statistically significant difference between the NNAT-I scores and chronological ages. Based on the results of the Scheffe test conducted for determining the groups with the age differences, a proportional correlation was determined between age and NNAT scores [5 years ($\bar{x}$= 18.64 (4.58)), 6 years ($\bar{x}$= 19.54 (5.57)), 7 years ($\bar{x}$= 23.02 (5.97)), 8 years ($\bar{x}$= 25.76 (6.29)) and 9 years ($\bar{x}$= 27.52 (5.80)]. It was set forth based on the results of the Anova analysis conducted based on the chronological ages of the children that there is a statistically significant difference between all age groups with regard to NNAT-I scores and chronological age $F(4.748) = 68.47$, $P < .01$. The calculated eta-square value was 8628.606/32191.459 = 0.27. Accordingly, it can be indicated that about 27% of the variance observed in NNAT scores is subject to chronological age.

It was determined when Table 6 was examined that NNAT-I average is 23.44 (7.39), CPM average is 24.65 (5.99), and TONI-3 average is 21.78 (6.53). A strong, positive, and statistically significant correlation was observed between NNAT-I and CPM, r = 0.84, $P < .001$). The correlation coefficient between the total scores for the 2 tests was calculated as .84. There is a moderate, positive, and statistically significant correlation between NNAT-I and TONI-3, $r = 0.52$, $P < .001$). The correlation coefficient between the total scores for the 2 tests was calculated as 0.52.

It can be observed when Figure 1 is examined that there the NNAT-I scores and Denver II Developmental Screening Test results display a certain parallelism. However, there are also sections where children with a developmental screening result of "Normal" display similarities with children who have a developmental assessment of "Abnormal and Suspicious" based on their NNAT-I total scores. Based on this finding, it is considered that there is a limited consistency between NNAT-I ability test and Denver II Developmental Screening Test.

Discussion

Norms for NNAT-I were developed in the present study for children in the 5-9 age group and findings were acquired which indicate that the test is reliable and valid.

Reliability scores display the internal consistency for NNAT-I. Scoring consistency and the confidence in the sensitivity increases with increasing reliability coefficient.[17] The Cronbach Alpha coefficients for NNAT-I test for individuals aged 5-17 among the USA population were determined between 0.89 and 0.95, while a perfect reliability was observed with an average reliability coefficient of 0.91.[9] The reliability analysis results conducted with a sample group comprised of participants from Philippines revealed an acceptable reliability coefficient of 0.84 for sixth-grade students.[18] Whereas in the present study, the Cronbach Alpha coefficients were determined in the interval of 0.80 and 0.88 for the NNAT-I test in the 5-9 age interval in the sample group putting forth an average reliability coefficient of 0.88. The obtained findings are in parallel with the original values of NNAT-I.

Naglieri (2003) conducted a study in which reliability was determined for the B Form as 0.93 for participants in the 5-8 age group, 0.94 for participants in the 9-17 age group, and 0.94 for all ages in general.[9] Whereas in our study, reliability was calculated for the B Form of NNAT-I test as 0.93 for participants in the 5-9 age group.

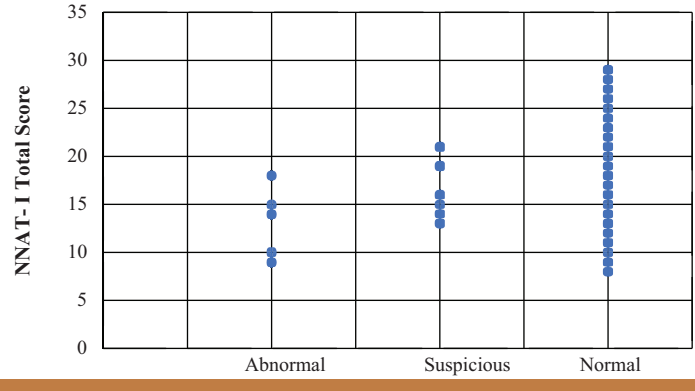


Figure 1. Graph for the NNAT-I total score and Denver II Developmental Screening Test results.

Based on the parallel form results, the correlation results of our study overlap with the original values of NNAT-I.

Examining the test-retest reliability is 1 way of predicting the reliability of a tool.[19] The same test is conducted twice with the same participants for examining test-retest reliability under as similar conditions as possible. The stability of NNAT-I scores was evaluated by applying Form A of NNAT-I twice on 88 participants with an interval of 4 weeks and on 62 participants with an interval of 8 weeks. The correlation coefficient in our study between the first application and the test-retest application conducted 4 weeks later was calculated as 0.88. The correlation coefficient between the first application and the test-retest application score conducted 8 weeks later was calculated as 0.87. Based on these findings, it was concluded that NNAT yielded consistent results with regard to age and time.

Naglieri (2003) carried out a study putting forth that there is no statistically significant difference regarding gender between NNAT-I, 5-17 ages.[9] A similar result was also obtained in the present study and it was determined that there is no statistically significant difference based on gender between the NNAT-I test scores for the 5-9 age sample group.

Criterion validity is expressed as the comparison of the results for a test measuring a standard performance or ability and the results for 1 or more tests that are considered to measure the same performance or ability.[19] Naglieri (2008; 2018) examined the relationship between NNAT versions. The findings show that correlations between NNAT-I and NNAT-II and the Naglieri Ability Index for NNAT-III and NNAT-II ranged from 0.77 to 0.79 and 0.73 to 0.79, respectively.[20,21] The revised correlation coefficient between NNAT-I and RSPM raw scores for the US norms prepared by Naglieri (2003) was calculated as 0.78.[9]

The magnitude of the correlation and effect suggests that NNAT-I measures the same construct as RSPM. A high, positive, and statistically significant correlation is observed between NNAT-I and CPM within the scope of the present study. The correlation coefficient between the raw scores of the 2 tests was calculated as 0.84. A high and statistically significant correlation was determined between NNAT-I and CPM. The statistically significant correlation values between NNAT-I Test and CPM test indicate that NNAT-I test is a valid tool for the assessment of nonverbal intelligence. Lohman et al (2008) emphasized the necessity of applying nonverbal tests such as CPM, NNAT to students learning English in order to be able to measure skills fairly.[8] Nonverbal measurements were designed to create opportunities for children with linguistic, cultural, and ethnic differences to show their potential.[22] However, it should be noted that this assumption is not supported by some studies. One of the reasons for this situation is that children get test scores that are higher than necessary due to insufficient norms in the assessments made with the assessment tool developed by Raven, and as a result, inconsistent placements are experienced.[8] NNAT-I average intelligence score was determined as 97,5 whereas TONI-3 average intelligence score was determined as 100,9 for the USA norms developed by Naglieri (2003). The revised correlation coefficient between the 2 tools was 0.63, whereas Cohen's *d* was determined as 0.27.[9] The correlation coefficient between the 2 tools was calculated as 0.52 and a moderate, statistically significant correlation was determined between the 2 scales. Reaching a statistically significant correlation value between NNAT-I test and TONI-3 test is an indication that NNAT-I test is a valid tool for the assessment of nonverbal intelligence. A correlation of 0.71 was determined between the first local Nonverbal Ability Test (BNV) developed in Turkey by Bildiren, Bıkmaz, and Korkmaz in 2021 and NNAT-I.[23] Acquiring statistically significant correlation values between NNAT-I Test and BNV test is an indication that NNAT-I test is a valid tool for the assessment of nonverbal intelligence.

Naglieri (2003) applied NNAT-I test on individuals with special needs within the scope of the validity tests for NNAT-I test. It was determined as a result of the study that the average standard score for gifted individuals is 130.1, the average standard score for individuals with mental deficiency is 65.3, the average standard score for individuals with hearing deficiency is 105.1, the average standard score for individuals with learning disability is 93.3 and the average standard score for individuals with language and speech disorder is 92.3.[9] Bölte et al. (2008) compared the RSPM and Wechsler Intelligence Test for Adults and Children scores for individuals with autism. It was illustrated that individuals with autism received higher scores for the RSPM test.[24] Since intelligence tests such as the Wechsler Intelligence Scale for Children (WISC) include questions about learned knowledge, mistakes can be made in intelligence measurements of children with or without special needs.[24,25] Therefore, using tests such as NNAT, TONI, CPM, BNV, and Wechsler Nonverbal Scale of Ability (WNV) may offer a fairer way to assess intelligence.[23,26–28]

This study has several limitations. The first, the NNAT-I norm and standardization study was carried out by collecting data from 1 province. The second is that the validity analyzes of NNAT-I could not be performed with the WISC-IV, ASIS, and WNV tests, which are widely used today.

The primary findings of the present study indicate that the utilization of NNAT-I test will be suitable for the cognitive assessment of children in the 5-9 age group. The findings also illustrated that age has a significant impact on the test scores proven to increase with age as expected from the NNAT-I scores. When contemporary studies are taken into consideration in addition to the validity results under development for the CPM and TONI-3 tests, it can be observed that both tests yield valid results. It is indicated that the findings of the present study provide important proof regarding the validity of NNAT-I. Low consistency between NNAT-I intelligence test and Denver II Developmental Screening Test is an indication that developmental assessment remains limited in predicting the intelligence levels of individuals. Because of their independence from language, nonverbal intelligence tests such as NNAT-I, NNAT-2, CPM, BNV, and TONI-3 can be used as the predictor of cognitive processes to assess the cognitive ability of individuals who speak different languages or come from different cultures and populations, especially to identify gifted individuals from different cultural and linguistic groups, to assess individuals with hearing impairment and individuals with language and speech disorders and to identify individuals with mental deficiency. These tests are widely used in individual practice, as well as in group practice. This situation may provide convenience for student screening .[6,9,20,23]

Ethics Committee Approval: *Ethical committee approval was received from the Ethics Committee of the Faculty of Health Sciences of Aydın Adnan Menderes University (Approval Number: 2020/005).*

Informed Consent: *Informed consent forms were obtained from all participants and their families.*

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References

1. McCallum RS. Context for nonverbal assessment of intelligence and related abilities. *Handbook of Nonverbal Assessment*. Cham: Springer; 2017:3-19.
2. Frisby CL. Straight talk about cognitive assessment and diversity. *Sch Psychol Q*. 1999;14(3):195-207. [CrossRef]
3. Lohman DF. The role of nonverbal ability tests in identifying academically gifted students: an aptitude perspective. *Gifted Child Q*. 2005;49(2):111-138. [CrossRef]
4. Balboni G, Naglieri JA, Cubelli R. Concurrent and predictive validity of the raven progressive matrices and the Naglieri Nonverbal Ability Test. *J Psychoeducational Assess*. 2010;28(3):222-235. [CrossRef]
5. Laura ST, Barbara AS. A guide to child nonverbal IQ measures. *American Journal of Speech-Language Pathology*. 2004;13(1):275-290.
6. Brown L, Sherbenou RJ, Johnsen SK. *Test of Nonverbal Intelligence: TONI-4*. Austin, TX: Pro-Ed; 2010.
7. Cotton SM, Kiely PM, Crewther DP, Thomson B, Laycock R, Crewther SG. A normative and reliability study for the Raven's Coloured Progressive Matrices for primary school aged children from Victoria, Australia. *Pers Individ Dif*. 2005;39(3):647-659. [CrossRef]
8. Lohman DF, Korb KA, Lakin JM. Identifying academically gifted English-language learners using nonverbal tests: a comparison of the Raven, NNAT, and CogAT. *Gifted Child Q*. 2008;52(4):275-296. [CrossRef]
9. Naglieri JA. *Naglieri Nonverbal Ability Test: Individual Administration*. San Antonio, TX: Harcourt Assessment; 2003.
10. Dinçer B, Özaslan M. *İlçelerin Sosyo-Ekonomik Gelişmişlik Sıralaması Araştırması*. DPT Bölgesel Gelişme ve Yapısal Uyum Genel Müdürlüğü; Ankara; 2004.
11. Nunnally JC. *Psychometric Theory*. 2d ed. McGraw-Hill; New York; 1978.
12. Raven JC, Court JH, Raven JE. *Raven's Coloured Progressive Matrices*. Harcourt Assessment. San Antonio; 1998.
13. Bildiren A. Tevhide K, Mediha K. Renkli Progresif Matrisleri Testi'nin 4-6 Yaş Aralığında Güvenirlik ve Şekerk Çalışması. *Türk Üstün Zekalılık ve Eğitim Dergisi*. 2017;7(1):19-38.
14. Korkmaz M, et al. TONI-3 Nonverbal Ability Testnin 6-11 Yaş Örneklemi Norm ve Standardizasyon Çalışması. *Anadolu Psikiyari Dergisi*. 2018; 19(1):76-83.
15. Frankenburg WK, Dodds J, Archer P, Shapiro H, Bresnick B. The Denver II: a major revision and restandardization of the Denver Developmental Screening Test. *Pediatrics*. 1992;89(1):91-97. [CrossRef]
16. Anlar B, Yalaz K. *Denver II Developmental Screening Test-Türk Çocuklarına Uyarlanması ve Standardizasyonu*. Ankara: Hacettepe Çocuk Nörolojisi Gelişimsel Tıp Araştırmaları Grubu; 1996.
17. Karasar NB. *Araştirma Yöntemi: Kavramlar, Ilkeler, Teknikler*. Ankara: Anı Yayıncılık; 2020;2(35):278-280.
18. Vista AD, Grantham G. *Transferability of Norms: Norming the Naglieri Nonverbal Ability Test (NNAT) in the Philippine Public Schools* [Diss]. Athens, United States University of Georgia; 2006.
19. Alpar R. *Uygulamalı istatistik ve geçerlilik güvenirlilik: Spor, sağlık ve eğitim bilimlerinden örneklerle*. Ankara: Detay Yayıncılık; 2020:577-580.
20. Naglieri JA. *Naglieri Nonverbal Ability Test*. 2nd ed. San Antonio, TX: NCS Pearson; 2008.
21. Naglieri JA. *Naglieri Nonverbal Ability Test Manual levels A-D*. 3rd ed. Pearson; London; 2018.
22. Naglieri JA, Ford DY. Increasing minority children's participation in gifted classes using the NNAT: A response to Lohman. *Gifted Child Q*. 2005;49(1):29-36. [CrossRef]
23. Bildiren A, Bıkmaz Bilgen ÖB, Korkmaz M. National nonverbal cognitive ability test (BNV) development study. *SAGE Open*. 2021;11(3). [CrossRef]
24. Bölte S, Poustka F, Constantino JN. Assessing autistic traits: cross-cultural validation of the social responsiveness scale (SRS). *Autism Res*. 2008;1(6):354-363. [CrossRef]
25. Grondhuıs SN, Lecavalier L, Arnold LE, et al. Differences in verbal and nonverbal IQ test scores in children with autism spectrum disorder. *Res Autism Spec Disord*. 2018;49:47-55. [CrossRef]
26. Eissa MA, Alsayed AF. The Raven's colored progressive matrices test: a normative data for gifted students in Egypt aged 10-17. *PERR*. 2012;1:86-92.
27. Gresham FM, MacMillan DL, Bocian KM. Learning disabilities, low achievement, and mild mental retardation: more alike than different? *J Learn Disabil*. 1996;29(6):570-581. [CrossRef]
28. Maller SJ, Braden J. Intellectual assessment of deaf people: a critical review of core concepts and issues. In: Marschark M, Spencer PE, eds., *The Oxford Handbook of Deaf Studies, Language, and Education*. Oxford University Press; Oxford; 2011;2:476–490.