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The diagnostic utility of the Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV) in identification of gifted children

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ABSTRACT
Accurate assessment and early identification of gifted children is of great importance in terms of providing them with educational programs tailored for their abilities in specific areas. Individually administered intelligence tests are widely used to identify gifted children, and an above-average level of intellectual capacity is generally accepted as the main criterion for giftedness. This study aimed to investigate the utility of the Turkish version of the Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV) to distinguish gifted children from non-gifted children. For this purpose, 201 gifted children and 201 non-gifted children were included in the study. To be able to determine the predictive power of the WISC-IV index and subtest scores, logistic regression analyses were performed. Results indicated that the Perceptual Reasoning Index, Working Memory Index, and Processing Speed Index scores (except Verbal Comprehension Index score), and all subtest scores significantly predicted giftedness. Furthermore, correct classification rates among gifted children were 93% for index scores and 97% for subtest scores. The findings of this study suggest that intelligence scores obtained from the WISC-IV have a diagnostic utility and provide valid and reliable results in identifying gifted children.

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Diagnostic utility; giftedness; intellectual assessment; non-giftedness; WISC-IV

Introduction
The term giftedness was first used by Terman (1925) and defined as “a degree of brightness that would rate them well within the top one percent of the population” (p. 19). One of the most comprehensive definitions, which includes specific characteristics of gifted children, was first proposed by Marland (1972). According to this definition (p. 10), children having higher performance or potential in one or more of the areas such as (a) general intellectual ability, (b) specific academic aptitude, (c) creative or productive thinking, (d) leadership capacity, (e) visual and performing arts, and (f) psychomotor ability than their developmentally normal peers are
identified as gifted (for detailed information, see Jolly & Robins, 2016). In his three-ring model, Renzulli (1978) reconceptualized the definition of giftedness by identifying three factors that are essential and work together for the development of gifted behavior: above-average general ability, high levels of creativity, and high levels of motivation (task commitment). Additionally, a group of researchers (also called Columbus Group) defined giftedness as “asynchronous development in which advanced cognitive abilities and heightened intensity combine to create inner experiences and awareness that are qualitatively different from the norm” (The Columbus Group, 1991, as cited in Morelock, 1992, p. 14). Lastly, in one of the contemporary giftedness models, the Munich Model of Giftedness, giftedness is conceptualized as “a multifactorized ability construct within a network of non-cognitive (e.g., motivation, interests, self-concept, control expectations) and social moderators which are related to the giftedness factors (predictors) and the exceptional performance areas (criterion variables)” (Heller, 2004, p. 306).

More specifically, gifted children may demonstrate intellectual or cognitive skills such as extraordinary abstract thinking, analytical thinking, distinctive thinking, unusual focusing, rapid learning, eagerness to learning, creativity, and effective imagination (Sattler, 2002). Therefore, gifted children may need special education programs, services, and activities, tailored for their abilities in academic and nonacademic fields, beyond typical educational programs (Hagmann-von Arx, Meyer, & Grob, 2008; Sattler, 2002; Simpson et al., 2002; Smutny & Blocksom, 1990). Thus, early assessment and identification of potentially gifted children are of great importance to develop the content of the educational programs appropriate for these children and maximize their potential (Huang, 2008; Pfeiffer, Kumtepe, & Rosado, 2006; Simpson et al., 2002; Yiğit, 2016; Yiğit, Çelik, & Erden, 2017).

Although the importance of early identification of gifted children is generally accepted, there are different views about which criteria or measurement tools should be used in the assessment process (Brown et al., 2005; Pfeiffer, 2002, 2003). These different views stem from the definitions or conceptualizations which emphasize various components of giftedness (Holocher-Ertl, Kubinger, & Hohensinn, 2008; Pfeiffer, 2003; Siegle & McCoach, 2010). For instance, while some studies define giftedness by taking into account an above-average general intelligence (Carman, 2013; McClain & Pfeiffer, 2012; Vaivre-Douret, 2011), other studies underline creativity and task commitment (or responsibility) in addition to high intellectual ability as criteria for identifying giftedness (Renzulli, 1978, 2012). Moreover, existing literature recognizes the role played by environmental factors (Ericsson & Charness, 1994; Howe, Davidson, & Sloboda, 1998) or
genetic predispositions (innate abilities) (Simonton, 1999). On the other hand, it has been suggested that inheritance factors and environmental factors are not mutually exclusive and that giftedness is the result of a complex and successive series of interactions between the two (Plomin & Price, 2003; Sternberg, 1996). Based on these different definitions or views, objective tests measuring intellectual or cognitive abilities, achievement, creativity, and personality traits, as well as parent/teacher surveys, observations, and portfolios have been employed in the identification of gifted children (Almeida, Araújo, Sainz-Gómez, & Prieto, 2016; Jarosewich, Pfeiffer, & Morris, 2002; McIntosh, Dixon, & Pierson, 2018; Pfeiffer & Blei, 2008; Sattler, 2002). Among these tools, individually administered intelligence tests are commonly used to identify children with high intellectual abilities and to determine whether they are placed in appropriate educational programs (McClain & Pfeiffer, 2012; Pfeiffer, 2002; Simpson et al., 2002).

Many intelligence tests have been developed [e.g., Standford-Binet Intelligence Test; (Roid, 2003); Woodcock-Johnson Cognitive Abilities Test (Schrank, McGrew, Mather, Wendling, & LaForte, 2014)] and used for intellectual assessment of children in both clinical and academic contexts (Kaufman & Lichtenberger, 2006; Sparrow, Pfeiffer, & Newman, 2005). Among these intelligence tests developed, one of the most commonly used tests in the assessment of gifted children is the Wechsler Intelligence Scale for Children (WISC). The fourth edition of the Wechsler Intelligence Scale for Children (WISC-IV) consists of 10 core and 5 supplementary subtests, which are administered to children aged between 6 and 16 years. The scale yields four index scores and the Full Scale Intelligence Quotient (FSIQ) score by using the ten core subtest scores (Wechsler, 2003a) (Table 1). On the WISC-IV, having a score of at least 130 (Sd = ±2) is the intellectual criterion for a child to be identified as gifted. Given the distribution of the standardization sample, gifted children represent 2.2% of the sample. That

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<th>Table 1. Subtests and Indexes of the WISC-IV.</th>
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<td><strong>Index</strong></td>
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<td>Verbal Comprehension Index (VCI)</td>
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<td>Perceptual Reasoning Index (PRI)</td>
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<td>Processing Speed Index (PSI)</td>
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is, they have higher intelligence scores than 97.8% of the sample (Holocher-Ertl et al., 2008; Sparrow et al., 2005).

Previous studies in the literature have investigated how gifted children perform or what cognitive profiles they have on the original version of the W. It has been shown that the old versions of WISC, such as WISC-Revised Edition (WISC-R) and WISC-Third Edition (WISC-III), yield valid and reliable results for the assessment of gifted children (Brown & Yakimowski, 1987; Sparrow & Gurland, 1998). In relation to the WISC-IV, the original standardization study examined the WISC-IV subtest and index scores of 63 children who had been previously identified as gifted (Wechsler, 2003a, p. 77). Results showed that gifted children had higher scores on the Verbal Comprehension Index (VCI = 124.7) and Perceptual Reasoning Index (PRI = 120.4) compared to the Working Memory Index (WMI = 112.5) and Processing Speed Index (PSI = 110.6). Furthermore, while the gifted children had the highest scores on Vocabulary, Similarities, Comprehension, and Arithmetic (supplementary) subtests, they had the lowest scores on Coding, Digit Span, and Cancelation (supplementary).

Similarly, in another study, Falk, Silverman, and Moran (2004) revealed that gifted children had the highest score on the VCI (131.7) and this was followed by the PRI (126.4), the WMI (117.7) and the PSI (104.3). Many studies have also supported the findings of these two studies (Guignard, Kermarrec, & Tordjman, 2016; Hagmann-von Arx et al., 2008; Molinero, Mata, Calero, García-Martín, & Araque-Cuenca, 2015; Rowe, Dandridge, Pawlush, Thompson, & Ferrier, 2014; Rowe, Kingsley, & Thompson, 2010; Yiğit et al., 2017). In light of all these studies, it can be concluded that gifted children perform better on the Verbal Comprehension Index and the Perceptual Reasoning Index (and subtests under these two indexes), which characterize abstract and visual reasoning, comprehension, and perceptual organization.

Furthermore, a few studies examined the structure of the WISC-IV among gifted children using confirmatory factor analysis. These studies revealed that four correlated factor structure of WISC-IV (Verbal Comprehension Index, Perceptual Reasoning Index, Working Memory Index, and Processing Speed Index) was confirmed (Molinero et al., 2015; Rowe et al., 2014). Furthermore, the Verbal Comprehension Index had non-significant or low covariances with other indexes as well as having the lowest factor load in representing general intelligence factor. Some studies using clinical samples documented that bifactor models in which subtests were directly associated with general intelligence in addition to the associated subtests with index factors, had better fit index values (Fenollar-Cortés, López-Pinar & Watkins, 2019; Styck & Watkins, 2016). As for the WISC-V, it has been revealed that the subtests are more compatible with
the four-factor structure than the five-factor structure that is claimed to exist in the original structure of WISC-Fifth Edition (WISC-V) (Canivez, Watkins, & Dombrowski, 2016; Canivez et al., 2020). These findings suggest that the pattern of subtests and indexes on both WISC-IV and WISC-V may differ from the original structure. Considering that similar situations may occur in assessing intellectual abilities of gifted children, the interpretation of the subtest, index, and general intelligence scores of the WISC-IV require comprehensive examinations.

Although the WISC-IV provides four index scores, Full Scale Intelligence Quotient is used as the main criterion to decide whether or not a child is gifted. However, some researchers have suggested that the Full Scale Intelligence Quotient does not fully represent the intellectual or cognitive abilities of gifted children (Falk et al., 2004; Flanagan & Kaufman, 2009; Silverman, 2005). Specifically, they have addressed that as Verbal Comprehension Index and Perceptual Reasoning Index scores of gifted children are quite higher than Working Memory Index and Processing Speed Index scores, remarkable variability may emerge between these index scores. Since the Full Scale Intelligence Quotient is calculated using all core subtest scores of the four indexes, these discrepancies between index scores may negatively affect the Full Scale Intelligence Quotient, causing it to be relatively low. When there are such disparities among index scores, consideration and interpretation of only Full Scale Intelligence Quotient may become a disadvantage for identification of gifted children (Flanagan & Kaufman, 2009; Silverman, 2005; Weiss, Saklofske, Prifitera, & Holdnack, 2006). Thus, a new composite score called the General Ability Index (GAI) was developed to provide additional flexibility to define broad intellectual abilities that may eliminate this disadvantage regarding the assessment for gifted children (Flanagan & Kaufman, 2009; Rimm, Gilman, & Silverman, 2008; Saklofske, Prifitera, Weiss, Rolphus, & Zhu, 2005). The GAI score is calculated based on six core subtests in the VCI and the PRI that gifted children perform better and does not include subtest scores in the WMI and the PSI. To be able to provide better implications for gifted children, it is recommended to use the GAI especially when the difference between index scores is 23 and above (Flanagan & Kaufman, 2009; Saklofske et al., 2005).

The above-mentioned studies provide evidence that the original version of the WISC-IV introduces valid and reliable results in detecting the intellectual strengths and weaknesses of gifted children. However, research to date has not yet determined whether subtest and index scores obtained from both the Turkish and original versions of the WISC-IV can distinguish gifted children from non-gifted children. The main purpose of the present study is to investigate whether the Turkish version of the WISC-IV
index and subtest scores have diagnostic utility or efficacy in determining giftedness in a sample of gifted and non-gifted children. The early and accurate identification of giftedness is highly crucial in terms of placing these children in institutions or specialized classes where they can benefit from educational opportunities appropriate for their cognitive skills and improve these skills. Through this study, we will investigate whether the use of WISC-IV in the assessment and identification of gifted children is functional. The Turkish version of the WISC-R (Savaşır & Sahin, 1995) has been widely used in hospitals, clinics, counseling centers, and educational institutions to assess children with high intellectual abilities or special educational needs (Çelik, Yigit, & Erden, 2015; Çelik, Yiğit, Erden, & Vural, 2016; Yiğit, 2016). The standardization and norm study of the Turkish version of the WISC-IV was finalized in 2013 and since then, it has been in use (Öktem, Erden, Gençöz, Sezgin, & Uluc, 2016). There is a limited number of research findings related to the use of this new version, which contains substantial changes compared to its old versions in terms of administration, content, and structure (Wechsler, 2003a; Yiğit, 2016; Yiğit et al., 2017). Given that cognitive profiles or performance of gifted children may differ compared to their non-gifted peers, the present study can provide important implications for researchers, practitioners, professionals working in educational institutions, and parents in order to better understand and identify cognitive abilities of gifted children. Moreover, enhancing the knowledge about the diagnostic efficacy of the Turkish version of the WISC-IV among gifted children can also ensure its cross-cultural utilization and validity.

Materials and Methods

Sample

The sample of the study consisted of two groups. The first group included 201 gifted children who were educated in special educational institutions that were designed for gifted education and affiliated to the Ministry of Education. The second group included 201 non-gifted children who were educated in primary or high schools in different cities in Turkey. The children in this group had an FSIQ score between 80 and 119. Both groups were similar in terms of age with a non-significant difference on t-test ($t(df = 400) = -.12, p > .05$). Of the gifted children, 43.8% ($N = 88$) were boys and 56.2% ($N = 113$) were girls with mean age of 11.09 years ($SD = 3.34$, range = 6–16 years). Of non-gifted children, 43.8% ($N = 88$) were boys and 56.2% ($N = 113$) were girls with mean of 11.11 years ($SD = 3.33$, range = 6–16). Children with any neurological or psychiatric diagnosis and
sensory-motor problems were excluded from the study. Moreover, we also excluded children who had been administered the WISC-IV within a year.

**Instruments**

**Wechsler Intelligence Scale for Children-Forth Edition (WISC-IV)** (Wechsler, 2003a) The WISC-IV is an individually administered intelligence test assessing intellectual abilities of children between the ages of 6 and 16 years (Wechsler, 2003a). It consists of 10 core subtests and 5 supplementary subtests. The WISC-IV provides four index scores, including Verbal Comprehension Index (Similarities, Vocabulary and Comprehension core subtests and Information and Word Reasoning supplementary subtests), Perceptual Reasoning Index (Block Design, Picture Concepts, and Matrix Reasoning core subtests and Picture Completion supplementary subtest), Working Memory Index (Digit Span and Letter-Number Sequencing core subtests and Arithmetic supplementary subtest), and Processing Speed Index (Coding and Symbol Search core subtests and Cancellation supplementary subtest). Additionally, the Full Scale Intelligent Quotient can be obtained from the sum of the 10 core subtest scores. The mean score is 100 ($SD = 15$) for all index scores and 10 ($SD = 3$) for subtest scores. By ensuring that all age ranges and seven geographical regions were represented in terms of population, sex, and socioeconomic status, 2225 children were included in the standardization and norm study of the Turkish version of the WISC-IV (Öktem, Erden, Gençöz, Sezgin, & Uluç, 2016). In this study, we used the Turkish version of the WISC-IV to assess intellectual abilities of gifted children.

**Procedure**

This study was approved by the … University Ethics Committee. Before administration of the test, approval of the school administration was acquired and written informed consent was obtained from parents of children to be assessed. The WISC-IV was administered to all children who participated in the study by certified psychologists. As outlined in the Turkish version of the WISC-IV Administration and Scoring Manual, standardized administration and scoring procedures were followed (Öktem et al., 2016). Children in the gifted group were recruited from Science and Art Centers (schools) that are educational institutions providing special education for gifted children. All gifted children had a WISC-R score of 120 and above, which is a criterion for placement for these centers, as well as academic achievement and other cognitive ability measures. For the aim of this study, the WISC-IV was administered to volunteer children who
were randomly selected from these centers. Children having a score of 120 and above on the WISC-IV were included in the study.

Data analyses

First, we examined descriptive statistics of the WISC-IV scores among both gifted and non-gifted children. For the main purpose of the present study, two separate logistic regression (binary) analyses were performed to investigate whether the WISC-IV index and subtest scores predicted giftedness. In regression analyses, we used the backward stepwise method in order to examine the effects of all variables simultaneously, considering the correlations between the WISC-IV scores. Furthermore, we entered the WISC-IV index and subtest scores as the predictor variables and two groups \((0 = \text{non-gifted}, 1 = \text{gifted})\) as the dependent variable. All of analyses were performed using the Statistical Package for the Social Sciences (SPSS, version 22).

Results

First, the WISC-IV scores of both gifted and non-gifted children were examined in terms of normality, and all scores were found to be in an acceptable range for normal distribution (Tabachnick & Fidell, 2007). Descriptive statistics of the WISC-IV index and subtest scores for both groups are presented in Table 2.
In the first logistic regression analysis, we examined whether the four WISC-IV index scores predicted giftedness. Results indicated that Perceptual Reasoning Index, Working Memory Index, and Processing Speed Index scores were significant predictors of giftedness (B = .26, Odds Ratio \(OR\) = 1.30, \(p < .001\), Confidence Interval [CI] [1.21, 1.40]; B = .17, \(OR = 1.18, p < .001, CI [1.13, 1.24]\); B = .18, \(OR = 1.20, p < .001, CI [1.14, 1.26]\), respectively), suggesting the diagnostic utility of these index scores. However, the Verbal Comprehension Index was not significantly associated with giftedness \((p > .05)\). The overall rate of correct classification for the model was 93.3%. The predictability among the gifted group was determined as 93% with the correct classification of 187 of 201 children. The predictability among the non-gifted group was determined as 93.5% with the correct classification of 188 of 201 children.

Similarly, we also tested whether the WISC-IV subtest scores predicted giftedness. Result showed that the nine subtest scores significantly predicted giftedness: Block Design (B = 1.25, \(OR = 3.49, p < .001, CI [1.85, 6.57]\)); Similarities (B = 1.15, \(OR = 3.16, p < .01, CI [1.33, 7.52]\)), Digit Span (B = 1.50, \(OR = 4.50 p < .001, CI [2.10, 9.66]\)), Picture Concepts (B = 1.57, \(OR = 4.80, p < .001, CI [2.29, 10.06]\)), Coding (B = 1.70, \(OR = 5.50, p < .001, CI [2.26, 13.36]\)), Vocabulary (B = 1.11, \(OR = 3.04, p < .01, CI [1.47, 6.28]\)), Matrix Reasoning (B = 1.07, \(OR = 2.93, p < .01, CI [1.55, 5.54]\)), Comprehension (B = 1.15, \(OR = 3.17, p < .001, CI [1.73, 5.79]\)), and Symbol Search (B = 1.00, \(OR = 2.70, p < .01, CI [1.44, 5.06]\)). These results suggest the diagnostic utility of these subtest scores. The overall rate of correct classification for the model was 97.8%. It was determined that the predictability among the gifted group was 97.5% with the correct classification of 196 of 201 children. Among the non-gifted group, the predictability was determined as 98% with the correct classification of 197 of 201 children.

**Discussion**

This study aimed to investigate the diagnostic validity of the Turkish version of the WISC-IV, which is one of the most commonly used intelligence tests to assess whether a child is gifted. More specifically, we investigated whether the WISC-IV index and subtest scores could distinguish gifted children from non-gifted children. The results of the study revealed that three index scores (Perceptual Reasoning Index, Working Memory Index, and Processing Speed Index) and all subtest scores except the Letter-Number Sequencing introduced a very high correct classification rate for both gifted and non-gifted children. These findings suggest that the WISC-IV scores provide valid and reliable results and can be used as the main criterion in identifying giftedness.
One of the main findings of the study was that three WISC-IV index scores (i.e., PRI, WMI, and PSI) were significant in predicting giftedness. In other words, these index scores have the diagnostic utility to distinguish gifted children from non-gifted children. As far as we know, there is no study in the literature that directly shows the predictive validity of the WISC-IV among gifted children. However, previous research has suggested that gifted children perform better in the WISC-IV Verbal Comprehension Index and Perceptual Reasoning Index compared to their non-gifted peers, and these two index scores represent giftedness better (Guignard et al., 2016; Molinero et al., 2015; Wechsler, 2003a; Yiğit et al., 2017). In this sense, it can be claimed that the finding of this study suggesting that the Perceptual Reasoning Index score significantly distinguished gifted children from non-gifted children is consistent with the previous findings. Specifically, it was shown that gifted children demonstrated higher intellectual capacity in areas such as nonverbal reasoning and visual perceptual skills. In this context, considering that the Perceptual Reasoning Index contributed to 40% of the general intelligence score, the distinctive feature of PRI, which captures these skills, is even more salient for gifted children. Finally, based on our findings, two important conclusions can be drawn. First, since the Perceptual Reasoning Index is a significant predictor of giftedness, it seems important that in the education of gifted children in both academic and nonacademic fields, enhancing the skills represented by this index should be focused on. Second, the fact that gifted children exhibit higher performance on the Perceptual Reasoning Index compared to their non-gifted peers can provide important clues for parents, teachers, and practitioners to be able to identify these children early, and this possibly results in the fulfillment of their special needs.

On the other hand, our finding, indicating that the Verbal Comprehension Index does not significantly predict giftedness, is contradicting the existing findings in the literature. Indeed, previous studies have revealed that the Verbal Comprehension Index is one of the strongest indicators of giftedness (Falk et al., 2004; Guignard et al., 2016). For example, Wechsler (2003a) revealed that among the gifted children taking place in the standardization sample, 27 out of 34 who scored 130 and above obtained this score from the Verbal Comprehension Index. One possible explanation for our finding is that there may have been substantial changes in the structure and content of the scale during the transition from the WISC-R (which has been in use for about 25 years in our country) to the WISC-IV. In the WISC-IV, more difficult questions were added to the subtests and the number of items was increased to be able to better represent gifted children (Wechsler, 2003a). This means that children assessed should correctly answer more questions in the WISC-IV in order to get the
same standard scores that they can achieve in the WISC-R. More importantly, significant changes were made in the content of the Similarities subtest measuring verbal comprehension skills, and the Information subtest on which gifted children performed better was moved to the group of supplementary subtests (Newman, Sparrow, & Pfeiffer, 2008; Wechsler, 2003a). Thus, as a result of revised test norms, some of the subtest scores may be lower in the new version of the test compared to the old version (Flynn, 2007; Kanaya, Scullin, & Ceci, 2003; Lufi et al., 1995; Uluç, Korkmaz, & Sahin, 2014; Yiğit et al., 2017) and this discrepancy in subtest scores between the two versions is likely to be more dramatic in terms of the identification of gifted children. In other words, although gifted children perform better on the subtests related to verbal comprehension skills than their non-gifted peers, score differences may not be sufficient to distinguish these two groups.

The findings of this research also suggested that Working Memory Index and Processing Speed Index significantly predicted giftedness. Accordingly, as children’s scores on these two indexes increase, they are likely to identify as gifted. Previous studies have shown that although gifted children perform worse in Working Memory Index and Processing Speed Index compared to Verbal Comprehension Index and Perceptual Reasoning Index (within-subject comparisons; e.g., Falk et al., 2004; Wechsler, 2003a; Yiğit et al., 2017), they perform significantly better in the cognitive abilities represented by Working Memory Index and Processing Speed Index than their non-gifted peers (between-subject comparisons; e.g., Hagmann-von Arx et al., 2008; Simpson et al., 2002; Wechsler, 2003a). In this respect, it can be said that this finding indicating that Working Memory Index and Processing Speed Index scores can distinguish gifted children from non-gifted children is relatively supported by previous findings; this also provides evidence that the structure of the WISC-IV as a whole is effective in determining giftedness. However, this finding still needs to be interpreted carefully. In particular, it is known that contrary to popular belief, some gifted children are not able to process information quickly and thus their performance on tasks requiring auditory memory skills and speed may be similar to the performance of their non-gifted peers (Silverman, 2005; Silverman, Gilman, & Falk, 2004). Consistent with previous studies, we also found in this study that gifted children had lower scores on Working Memory Index and Processing Speed Index than other indexes. Considering the contradictory findings in the literature, it is recommended that when determining giftedness, the patterns among index scores can also be taken into account instead of considering only the Working Memory Index and/or Processing Speed Index. On the other hand, if there are substantial differences between index scores, using the General Ability Index
instead of the Full Scale Intelligent Quotient can provide more valid results (Flanagan & Kaufman, 2009; Silverman, 2005).

Another finding of the study was that all subtest scores except the Letter-Number Sequencing significantly predicted giftedness. This finding is in line with the previous studies and suggests that in the identification of gifted children, interpretation of the WISC-IV scores can be made based on subtest levels (Silverman, Gilman, & Falk, 2004). Indeed, in the process analysis page of the record form of the WISC-IV, comparisons can be made by addressing the strengths and weaknesses of children based on the prevalence of subtest scores in the norm group (Wechsler, 2003a). In this context, this finding suggests that it is possible to determine the strengths and weaknesses among the subtests and to develop such a cognitive profile for a gifted child. In other words, although subtest scores are not used to identify giftedness, demonstrating which cognitive skills contribute to giftedness can provide valuable information in terms of both assessments of these children and the preparation of content for educational programs. Lastly, although this is the first study to examine the predictive power of the WISC-IV subtest scores on giftedness, previous findings pointing out subtest score differences among gifted and non-gifted children (e.g., Hagmann-von Arx et al., 2008) also support the notion that the WISC-IV subtest scores can have distinctive effects on the identification of giftedness.

Moreover, it was seen that the Letter-Number Sequencing subtest did not significantly predict giftedness. A few studies have shown that the Letter-Number Sequencing subtest measuring auditory and verbal working memory skills is among the subtests in which gifted children take lower scores (e.g., Wechsler, 2003a; Yiğit et al., 2017). In addition, previous research has suggested that gifted children achieve higher scores in the Arithmetic subtest, which was a core subtest in previous versions of WISC and became the supplementary test of the Letter-Number Sequencing subtest in the WISC-IV. In this respect, employing the Arithmetic subtest instead of the Letter-Number Sequencing subtest (especially for those who have not math phobia) may provide better information for predicting giftedness (Silverman et al., 2004); this is also likely to eliminate the disadvantage for gifted children.

Identifying children with a potential for higher cognitive skills is of critical importance in terms of providing them with appropriate education and opportunities. This requires the use of a valid and reliable measurement tool in the assessment of these children. This measurement tool should be able to provide an accurate assessment of the cognitive skills of both gifted and non-gifted children. More specifically, failure in the assessment may cause gifted children to be placed in regular educational programs that cannot meet their needs (Type I error), which in turn may lead to atrophy in
the cognitive skills and the emergence of some psychological and adaptation problems. On the other hand, when non-gifted children are identified as gifted (Type II error), they probably may not display expected cognitive performances and academic success and may also experience psychological problems. In this study, the correct classification rate of the WISC-IV index and subtest scores was found to be around 97.8% and 93.3%, respectively. On average, 95 out of every 100 children were correctly classified based on the WISC-IV scores. Taken together, the present study suggests that WISC-IV can be used as a powerful diagnostic tool in the identification of gifted children. In other words, the WISC-IV can classify gifted children correctly and educational planning and programs can be developed in line with findings from the WISC-IV.

It is known that giftedness consists of various components (e.g., creativity, academic achievement, leadership skills) as well as superior intellectual performance. For this reason, it is important to take into consideration that only intellectual assessment may not be sufficient in identifying gifted children. Although the WISC-IV stands out as a powerful measurement tool in predicting giftedness, it has been developed to assess general cognitive skills in the context of the Cattell-Horn-Carroll (CHC) theory. Therefore, performing a multifaceted assessment in the identification of giftedness will ensure that a child’s strengths and weaknesses are fully addressed and reduce the likelihood of misclassification. Additionally, when a multifaceted approach is used to assess children, it is strongly recommended to include an intelligence test among the other measurement tools (Klein, 2000; Pfeiffer, 2001; Sattler, 2002).

In our country, the WISC-IV has been widely used in the assessment of children for both clinical and research purposes since its release in 2013. In the Turkish standardization and norm study of the WISC-IV (Öktem et al., 2016), only patterns of index and subtest scores of the standardization sample were provided. Although there is a limited number of studies focusing on the diagnostic groups, more recent studies have focused on the Turkish version of the WISC-IV cognitive profiles of children with attention deficit hyperactivity disorder (Çelik, Erden, Özmen, & Hesapçıoğlu, 2017) and specific learning disorder (Çelik, 2019). Similarly, very little is known about the WISC-IV cognitive profiles of gifted children (Yiğit, 2016; Yiğit et al., 2017). Intelligence test scores have been observed to increase systematically around the world (Flynn, 1987; Kanaya et al., 2003) as a result of an increase in schooling, enrichment in environmental stimulus, increased familiarity with the test, and developments in the nutrition and health fields (Lynn, 2009). This increase in intelligence scores (known as the Flynn effect) compromises the validity of intelligence tests, with children having higher performance on the test. Thus, intelligence tests have been
updated periodically to have a new standardization and norm sample. In our country, the WISC-R, which is one of the oldest versions of the WISC, has been used in intellectual assessments for approximately 40 years. A few studies suggested that unexpected or confusing test results on the Turkish version of WISC-R have been documented, as the difficulty level of subtest items has changed over time (e.g., some difficult items might become easier for gifted children or ratio of the correct response to easy items might decrease) (Çakır, Erden, Akgiray, & Demir, 2006; Demir, Erden, & Adali, 2006). As such, –as a result of both obsolete norms and possible misleading test results– the transition from the WISC-R to the WISC-IV has been inevitable to have a reliable and valid assessment of gifted children. In this sense, the findings of this study can provide noteworthy knowledge and implications about intellectual characteristics of gifted children for both researchers and practitioners.

Specifically, our findings from the present study can contribute to the cross-cultural validity of the WISC-IV. The WISC-IV has been employed by many countries to assess intellectual abilities of children with special needs. The consistency between the findings of previous studies in those countries and our findings provides evidence that the WISC-IV subtest and index scores have the same meaning across different cultures, suggesting that the WISC-IV yields reliable and valid results. Considering that culture and language may affect the structure of the intelligence test, examining cross-cultural validity of the WISC-IV, as in our study, can enable researchers to interpret cultural differences in intellectual abilities of gifted children as well as to compare their test performance culturally. Additionally, prior research has been mostly focused on testing the factor structure of the WISC-IV in gifted samples or on comparing cognitive abilities of gifted and non-gifted children. However, this study appears to be the first study to examine the predictive (diagnostic) power of the WISC-IV subtest and index scores in a sample of gifted and non-gifted children. Accordingly, our findings have significant implications for the understanding of the strengths and weaknesses of gifted children in terms of intellectual abilities, which can help to develop the content of specialized education for these children. Moreover, our findings also highlight the importance of the use of intelligence scores in the early and accurate identification of potentially gifted children, possibly enabling practitioners to recognize their intellectual abilities and thereby maximize their potential by providing guidance.

Lastly, some gifted children may have some unrecognized learning difficulties at different levels and areas such as writing and mathematics (Brody, & Mills, 1997; McCoach et al., 2001). For example, when gifted children are not given the opportunity to study at their intellectual level
and pace, they may not do their best and learn to take the easy way out in given tasks. Furthermore, those who get high scores in their lessons with little effort may have less confidence or motivation to undertake difficult tasks or may be unwilling to improve themselves. Thus, it is critical to identify giftedness early and accurately to prevent such failures and problems. Suggesting that the WISC-IV is a sound tool to distinguish gifted children from non-gifted children, this study can provide practitioners and educators with proper guidance to determine giftedness, and prospective problems they may encounter.

The present study has several limitations. The first limitation of the study is related to generalizability. To date, various cutoff points of Full Scale Intelligent Quotient were proposed to define superior intelligence. Even though children with a Full Scale Intelligent Quotient of 125 and above (Sd = ±2) are defined as "gifted" in some sources, the technical books of WISC-IV and Wechsler Intelligence Scale for Adults-Fourth Edition (WAIS IV) suggested a “superior intelligence” classification for children with a Full Scale Intelligent Quotient of 120 and above (Wechsler, 2003b, 2008). Likewise, while Karnes and Brown (1980) used a cutoff score of 119, Hollinger and Kosek (1986) used a cutoff score of 130, and Fishkin, Kampsnider, and Pack (1996) used a cutoff score of 127. In fact, a contradiction is still present, of what would be the IQ cutoff score should be. In Turkey, children are expected to have a total IQ score of 120 and above, as well as other related academic achievement criteria, to be considered as gifted and only then, they could be eligible to attend private schools that designed for gifted children (Yiğit, 2016; Yiğit et al., 2017). Accordingly, the present work considered children with a Full Scale Intelligent Quotient of 120 and above on the Turkish version of the WISC-IV as gifted (Yiğit, 2016; Yiğit et al., 2017). Since our sample of gifted children is not representative of all gifted children, our results may be generalized to gifted children having similar characteristics. Furthermore, future studies investigating the cognitive profiles of gifted children with Full Scale Intelligent Quotient of 130 or more are needed. The second limitation is that although it is stated that giftedness has various components, this study only aimed to investigate the diagnostic utility of the WISC-IV scores. Thus, future studies may include different assessment tools (e.g., creativity or achievement tests) to investigate giftedness as a whole. In addition to this, future research also should include some demographics that may affect (or predict) giftedness. Third, the General Ability Index score which was stated to capture the spectrum of cognitive abilities of gifted children better was not included in this study because it was not within the scope of our main purposes and there was no norm study related to the General Ability Index. Even so, a comparison of the General Ability Index and the Full
Scale Intelligent Quotient scores can contribute to our understanding of which scores on the WISC-IV are more effective in predicting giftedness. Fourth, we could not adjust for training effects in gifted education, which may affect our results. Thus, to eliminate possible training effects (or the effects of other confounding variables, further research could assess the differences in cognitive abilities of gifted and non-gifted children at the beginning of their education programs. Lastly, in studies conducted with gifted students, it has been shown that these children can be classified as “under-achiever” or “over-achiever.” In the present study, we recruited only over-achiever gifted children; thus, an investigation into cognitive abilities of under-achiever gifted children is recommended in future studies.

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