Bartın University Journal of Faculty of Education
BUEFAD Volume 13, Issue 3

735-750
dergipark.org.tr/buefad
DOI: 10.14686/buefad.1334259

Cognitive Abilities in Early Childhood: An Exploration Across Gender, Age Group, School Type, and Parental Educational Status

Zerrin Mercan [a*] **,** ***Ümmühan Akpınar*** [b] **,** ***Mustafa Kocaarslan*** [c]

a Dr., Bartın University, https://orcid.org/0000-0002-9263-4363, *zmercan@bartin.edu.tr
b Dr., Bartın University, https://orcid.org/0000-0001-8107-6004
c Assoc. Dr., Bartın University, https://orcid.org/0000-0003-3918-6589

Research Article
Received: 28.7.2023
Revised: 28.8.2023
Accepted: 17.9.2023

Abstract

In this investigation that scrutinized the cognitive abilities of children aged 60-84 months, a causal-comparative design was adopted. The cohort under examination was composed of 120 children attending state-operated independent preschool educational facilities and primary schools. The data collection process employed a personal information form and the Cognitive Abilities Test (CogAT) Form -6, developed by Lohman and Hagen (2000). The internal consistency coefficient (KR-20) in this study for the overall test, subtest, and battery scores ranged between .69 and .93. The findings of this investigation indicated that gender did not significantly influence the total CogAT scores of participants. However, in subtests and batteries, boys demonstrated a significant advantage over girls in the *matrices* subtest and non-verbal aptitude battary. In general, an increase was observed in both the battery and total test scores with advancing age group and grade level. Regarding the influence of maternal education, children whose mothers held a bachelor's degree showed significantly higher verbal battery scores compared to those whose mothers had primary or secondary schooling. While there were some exceptions, there was a significant increase in cognitive abilities corresponding with the rise in the father's education level.

Keywords: cognitive abilities, early childhood, CogAT-6

Erken Çocukluk Döneminde Bilişsel Yetenekler: Cinsiyet, Yaş Grubu, Okul Türü ve Anne-Baba Öğrenim Düzeyi Açısından Bir Karşılaştırma

Öz

60-84 aylık çocuklarının bilişsel yeteneklerinin incelendiği bu araştırmada, nedensel karşılaştırma modeli kullanılmıştır. Araştırmanın çalışma grubu devlete ait bağımsız okul öncesi eğitim kurumları ve ilkokullardaki 120 çocuktan oluşmaktadır. Veri toplama sürecinde kişisel bilgi formu ve Lohman ve Hagen'ın (2000) Bilişsel Yetenekler Testi Form-6 kullanılmıştır. Testin bütün, alt test ve batarya puanlarına ilişkin KR-20 içtutarlılık katsayısı .69 ile .93 arasındadır. Araştırma sonucunda katılımcıların CogAT test puanları cinsiyete göre toplam puan açısından anlamlı farklılık göstermediği ancak alt testler ve bataryalarda erkek öğrencilerin matrisler alt testi ve sözel olmayan bataryada kız öğrencilerden anlamlı şekilde yüksek puan aldığı bulunmuştur. Genel olarak yaş grubu ve sınıf düzeyi arttıkça hem batarya hem de toplam test puanının da arttığı gözlenmiştir. Anne öğrenim düzeyi lisans olan çocukların sözel batarya puanları, anne öğrenim düzeyi ilkokul veya ortaokul olan gruptan anlamlı derecede yüksek olduğu görülmüştür. Bazı istisnalar dışında baba eğitimi düzeyi yükseldikçe bilişsel yeteneklerin de anlamlı olarak arttığı tespit edilmiştir.

Anahtar Sözcükler: bilişsel yetenekler, erken çocukluk, Bilişsel Yetenekler Testi Form-6

To cite this article in APA Style:

Mercan, Z., Akpınar, Ü., & Kocaarslan, M. (2024). Cognitive abilities in early childhood: An exploration across gender, age group, school type, and parental educational status. *Bartın University Journal of Faculty of Education, 13*(3), 705-721. https://doi.org/10.14686/buefad.1334259

INTRODUCTION

Cognitive competencies, which are pivotal predictors of academic prowess and school performance in early childhood (0-8 years), encompass a suite of fundamental abilities that ought to be identified and cultivated from an early stage (Gustafsson, 2008; Kaufman et al., 2012). These abilities embody a diverse range of cognitive activities including reasoning, forecasting, discerning cause-effect relationships, evaluation, elicitation of new meanings, generalization, conclusion drawing, transposition of derived results to varying scenarios, problem-solving, and application of acquired knowledge and experiences in novel situations (İnal & Ömeroğlu, 2011; Lohman & Hagen, 2003).

In the context of early childhood, cognitive capacities can be appraised through verbal, quantitative, and non-verbal (visuospatial) reasoning proficiencies. Verbal reasoning refers to the capacity to derive conclusions based on the understanding and evaluation of conceptually expressed words. Quantitative reasoning, on the other hand, implies the capacity to reach conclusions contingent upon mathematical relationships (Lohman & Hagen, 2003), whereas spatial reasoning denotes the ability to formulate conclusions grounded in the relationships among visually presented symbols or figures (Aiello, 2002).

Reasoning skills underpin the development of fundamental cognitive capabilities such as problem-solving, creativity, and critical thinking, which are indispensable for contemporary individuals. It is through these reasoning skills that an individual adapts to the rapidly changing, dynamic environment in which they find themselves, thereby equipping them with the necessary toolkit to contribute to both personal and societal betterment. Consequently, the imperative for scientific research devoted to the identification and enhancement of reasoning skills, both in terms of volume and quality, cannot be overstated, particularly with an emphasis on early childhood (Mercan, 2021; Zimmerman, 2000).

Theoretical Framework

Cognitive abilities, which encompass the effective deployment of fundamental cognitive processes such as reasoning, problem-solving, and critical and creative thinking, are often associated with the construct of intelligence within the scholarly literature (Alp & Diri, 2003; İnal, 2011; Tillman, Bohlin, Sørensen, & Lundervold, 2009). The concept of intelligence has been a subject of various interpretations across centuries and scholars have propounded multiple definitions. In certain contexts, intelligence is linked with the capability to adapt to the environment, in others, it is connected with the effective use of thinking skills, and yet in others, it is related to the ability to solve problems and to ensure survival (Arslan, 2018; Fry & Hale, 2000; Korkman, 2020; Oktay, 2019). The Cognitive Ability Test (CogAT) was developed utilizing the concept of intelligence, drawing inspiration from Vernon's hierarchical intelligence model and Cattell's fluid-crystallized abilities models (Alp & Diri, 2003; Patterson, 2012). Thus, the theoretical foundations for this study were deemed to be Philip E. Vernon's hierarchical intelligence model and Raymond B. Cattell's fluid-crystallized abilities models.

According to Spearman, intelligence can be bifurcated. Consequently, intelligence is classified into two categories: general intelligence (g) and specific intelligence (s). While general intelligence encapsulates the foundational elements of intelligence measured in intelligence tests, specific intelligence is defined as intelligence that comprises particular capabilities. Thus, while general intelligence encompasses all forms of an individual's mental activity, specific intelligence is a mental power required beyond the general ability to demonstrate a specific capability (Horn & McArdle, 2007; Korkman, 2020). Although Spearman's theory of intelligence occasionally faces criticism from various scholars (e.g., Thurstone) (Korkman, 2020), it is recognized as a seminal theory that forms the bedrock of intelligence theories, considering intelligence in multiple domains (Cocodia, 2014; Daniel, 1997; Dündar, 2019).

Thurstone proposed that intelligence is too multifaceted to be determined by a singular factor alone (Dündar, 2019; Erinç, 2022; Kubinger, Litzenberger, & Mrakotsky, 2006). Consequently, intelligence can manifest into a certain number of primary abilities. These abilities are categorized under seven primary headings: numerical problem-solving/numerical skills, verbal comprehension, memory, general reasoning, verbal fluency, spatial skills, and perceptual speed (Ardila & Bernal, 2007; Arslan, 2018; Korkman, 2020). The congruity between Thurstone's and Spearman's models of intelligence resides in their perception that these abilities are autonomous of each other. Vernon's hierarchical model of intelligence bridges the gap between Spearman's and Thurstone's models of intelligence (Patterson, 2012; Yılmazçetin, 2021). Vernon characterized intelligence as "the ability to think in multiple ways" (Kavcar, 2011). In Vernon's view, intelligence is structured in hierarchical layers. Thus, the apex layer of the model comprises general intelligence. This type of intelligence aligns with the "g" factor as defined by Spearman. The middle layer houses minor and major group factors, with major group factors including educational or verbal, mechanical, or practical. The minor group factors encompass verbal, numerical, educational, practical, mechanical, spatial, and physical abilities. The bottom layer consists of specific abilities (Guilford, 1967; İnci, 2021; Sözel, 2017; Vernon, 1961; Yılmazçetin, 2021). Vernon's hierarchical intelligence model is illustrated in Figure 1:

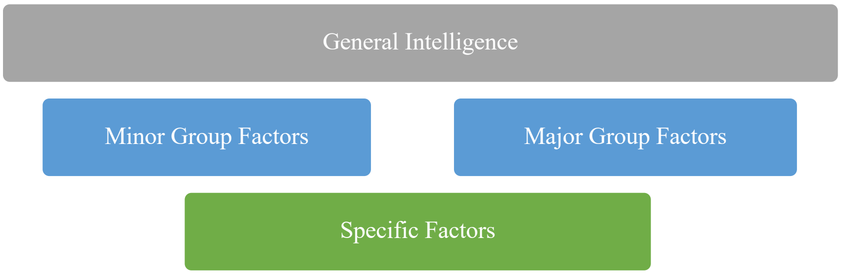

Figure 1. *Vernon's Hierarchical Model of Intelligence*

Cattell, in contrast, introduced two distinctive types of intelligence in his theory of fluid and crystallized intelligence. These are fluid intelligence (Gf) and crystallized intelligence (Gc). According to Cattell, fluid intelligence is the capacity to discern and formulate relationships in relation to the maturation of the brain and is linked to hereditary factors. While fluid intelligence is regarded as the inherited ability to think flexibly and abstractly, crystallized intelligence is defined as intelligence that is influenced by experience and education (Arslan, 2018; Cattell, 1967; Horn, 1985; Oktay, 2019). Fluid intelligence (Gf) pertains to the mental processes that are not performed automatically but are voluntarily and consciously used by the individual. Some of these mental processes include the ability to infer and transfer insights to other situations, problem-solving, concept formation, categorization, generating, testing, and understanding hypotheses. Inductive and deductive reasoning, speed of reasoning, and quantitative reasoning are sub-dimensions of fluid intelligence (Avcı Doğan, 2022; Heit & Rotello, 2010). Crystallized intelligence (Gc) encompasses skills acquired through the utilization of cultural knowledge, language, and concepts. Sub-dimensions of crystallized intelligence include verbal knowledge, language development, language ability, general knowledge, cultural knowledge, sensitivity to grammar, and predisposition to foreign languages (Schipolowski, Wilhelm, & Schroeders, 2014; Tamul, 2017).

The Present Study

A review of the literature on cognitive abilities reveals numerous scientific studies conducted both nationally and internationally over many years (Bickley, Keith, & Wolfle, 1995; Broberg et al., 1997; Halpern, 2004; Lakin & Gambrell, 2014). While national studies have primarily focused on scale adaptation (Akşin Yavuz, 2016; Bildiren, Kargın, & Korkmaz, 2017; İnal & Ömeroğlu, 2011), international studies have connected intelligence with academic achievement, gender, age, cognition, and thinking skills (Daseking, Petermann, & Waldmann, 2017; Kaur, Awasthy, & Syed, 2019; Otero, Salgado, & Moscoso, 2022; Palejwala & Fine, 2015; Weiss et al, 2021). However, it is evident that existing studies are limited in national contexts and include broad age ranges in international contexts. Thus, it is clear that there is a need for more studies predicting cognitive abilities in early childhood. Moreover, the fact that general cognitive ability is one of the most significant predictors of academic achievement underscores the importance of this research (e.g., Neisser et al., 1996; Rohde & Thompson, 2007; Spinath et al., 2006). In light of this need, the primary objective of this study was to examine the cognitive abilities of 60-84-month-old children in terms of gender, school type, age group, and parental education level. In this vein, the study sought answers to the following research questions:

- RQ(1). What are the Cognitive Ability Test (*CogAT*) scores of the participating children in terms of total, subtest, and battery?
- RQ(2). Do the Cognitive Ability Test (CogAT) scores of the participating children significantly differ according to the type of school?
- RQ(3). Do the Cognitive Ability Test (CogAT) scores of the participating children significantly differ according to gender?
- RQ(4). Do the the Cognitive Ability Test (CogAT) battery scores (verbal aptitude, quantitative aptitude, non-verbal aptitude) of the participating children significantly differ according to age groups?
- RQ(5). Do the Cognitive Ability Test (CogAT) battery scores (verbal aptitude, quantitative aptitude, non-verbal aptitude) of the participating children significantly differ according to the level of parental education?

METHOD

Research Design

This research was conducted according to the causal-comparative model within the framework of a quantitative research approach. Causal-comparative research is a type of investigation designed to determine the causes of certain conditions, situations, or phenomena, the variables that are presumed to influence these causes, or the outcomes of a particular effect (Büyüköztürk et al., 2022; Fraenkel, Wallen, & Hyun, 2012). In this context, the aim was to discern whether the categorical independent variables of gender, school type, age group, and parental education level led to differences in the cognitive abilities of the participating children.

Participants

Table 1. Demographic Information About the Participants

Variable	*N*	%
Gender		
Girl	63	52.5
Boy	57	47.5
Total	120	100
Age Groups		
60-66 months	39	32.5
67-72 months	25	20.8
73-84 months	56	46.7
Total	120	100
School Type		
Preschool	63	52.5
Primary School	57	47.5
Total	120	100
Mother's Level of Education		
Primary/Secondary School	18	15.0
High School	23	19.2
Associate Degree	14	11.7
Bachelor's	43	35.8
Postgraduate	10	8.3
Total	108*	90
Father's Level of Education		
Primary/Secondary School	9	7.5
High School	23	19.2
Associate Degree	12	10.0
Bachelor's	52	43.3
Postgraduate	12	10.0
Total	108*	90.0

Note. * Some participants' parental education information could not be reached.

Table 1 presents the demographic information about the 120 participants of the study. Gender distribution was almost even, with 52.5% of participants being girls (63 participants) and 47.5% being boys (57 participants). Participants were further grouped into three age categories: 60-66 months (32.5%, 39 participants), 67-72 months (20.8%, 25 participants), and 73-84 months (46.7%, 56 participants). Regarding the type of school attended by the participants, 52.5% were from preschools and 47.5% were from primary schools, reflecting the same distribution as gender. The level of education of the children's parents was also collected, though some participants' parental education information could not be reached (totaling to 90% data coverage). For mothers, 15% had primary or secondary education, 19.2% had high school education, 11.7% had an associate degree, 35.8% had a bachelor's degree, and 8.3% had postgraduate education. For fathers, the distribution was slightly different: 7.5% had primary or secondary education, 19.2% had high school education, 10% had an associate degree, 43.3% had a bachelor's degree, and 10% had postgraduate education.

Data Collection Tools

This research utilized a personal information form and the "Cognitive Abilities Test" (CogAT) as the primary tools for data collection. The personal information form captured details about the children and their parents, such as the child's gender, age, school type, and the education level of the parents. The CogAT, developed by Lohman and Hagen (2000) and validated by İnal and Ömeroğlu (2011), is rooted in theories of intelligence—particularly Vernon's hierarchical intelligence model and Cattell's theory of fluid and crystallized intelligence. The version of the test used in this study was CogAT Form-6, designed specifically for early childhood children. It consists of three subtests focusing on verbal, numerical, and non-verbal reasoning. Each subtest contains 40 items, totaling 120 items for the full test. During the test, children are presented with a directive, under which are visuals with four options. They are asked to select the appropriate option, scoring 1 point for a correct answer and 0 for an incorrect answer. The total score is the sum of correct answers from all subtests. The internal consistency of the CogAT for this research, calculated using KR-20, is provided separately for subtests, batteries, and the whole test in Table 2.

Table 2. Internal Consistency Coefficients of the CogAT for the Whole Sample

Variable	KR-20	N
Subtests		
Oral Vocabulary	.75	120
Verbal Reasoning	.72	120
Relational Concepts	.74	120
Quantitative Concepts	.84	120
Figure Classification	.79	119
Matrices	.69	119
Batteries		
Verbal Aptitude[a]	.84	120
Quantitative Aptitude[b]	.86	120
Non-Verbal Aptitude[c]	.85	119
Whole Test (CogAT-Total)	.93	119

Note. [a]= Oral Vocabulary + Verbal Reasoning;
[b]= Associated Concepts + Quantitative Concepts;
[c] = Figure Classification+ Matrices

Table 2 reveals the internal consistency coefficients of the CogAT, calculated using the KR-20 method. The internal consistency coefficient was .93 for the entire test, .84 for Verbal Aptitude, .86 for Quantitative Aptitude, and .85 for Non-Verbal Aptitude. Regarding subtests, the internal consistency coefficients ranged from .69 to .84. The quantitative concepts subtest had the highest internal consistency, while the matrices subtest had the lowest. These values suggest that the test exhibits good internal consistency for both the overall test and the sub-competencies (Büyüköztürk, 2021). This indicates that the test is reliably measuring the constructs it is intended to measure.

Data Collection Process

The data gathering phase commenced with obtaining requisite permissions from the pertinent institutions and organizations. Subsequent to this, the researchers engaged with the management personnel of the respective institutions, elucidating the objectives of the research. Over an 8-week period, the researchers conducted the data collection 3 times per week at the selected schools. The researchers interacted with the children in a serene environment, introducing themselves and delineating the purpose of the test. Willingness to participate was ascertained from each child on a voluntary basis. The children were assembled in small groups of 4-5 individuals, arranged so that their responses remained private, preventing the potential influence of their peers' answers. Concurrently, adherence to the researchers' instructions was closely monitored.

In an effort to clarify the test process, the researchers commenced by explaining and responding to the sample questions in tandem with the children. Once this was completed, the children were encouraged to concentrate on the test, with every effort being made to ensure that they independently recorded their responses. The children's responses were noted on the test form by the researchers. Bearing in mind the developmental stages of the children, the subtests were administered over different time periods, thereby tailoring the procedure to the children's readiness level. The testing was therefore completed over one, two, or three sessions, as appropriate.

Data Analysis

IBM SPSS 25 software was utilized for data analysis. To validate the normality of the data, the measures of central tendency, skewness, and kurtosis values of the CogAT for the entire test, subtests, and ability levels were scrutinized separately. Literature review indicates that when the mean, median, and mode are closely similar and the skewness and kurtosis values fall between -2 and +2, the data can be deemed to follow a normal distribution (George & Mallery, 2003; Green & Salkind, 2005). Upon reviewing Table 3, it is evident that the measures of central tendency for the total CogAT score, the subtests and battery scores align closely with each other; the skewness and kurtosis coefficients fall between -1 and 1. This suggests that the data adhere to a normal distribution. For the reliability assessment of the test, the KR-20 internal consistency coefficient was computed for the total score, subtest scores, and battery scores. Additional statistical methods such as descriptive statistics, Independent Sample T-test, and One-way Analysis of Variance (One-way ANOVA) were employed to scrutinize the research questions. Cohen's d was utilized to determine the effect size in the Independent Sample t-tests with .2 indicating a small effect size, .5 a medium effect size, and .8 a large effect size. For the One-Way Analysis of Variance, the effect size was computed with Eta-square (η2), where an η2 value of .01 signifies a small effect, .06 a medium effect, and .14 a large effect (Cohen, 1988; Green & Salkind, 2004). Statistical significance was established at a 0.05 significance level. The statistical values demonstrating the normality of the data are presented in Table 3, and the normal distribution curve for the overall CogAT test score is depicted in Figure 2.

Table 3. Statistical Values Related to Normality of Data

Variables	M	Med.	Mod.	Skewness	Kurtosis	N
Subtests						
Oral Vocabulary	15.22	16.00	18.00	-.81	-.06	120
Verbal Reasoning	12.70	13.00	17.00	-.10	-.90	120
Relational Concepts	11.09	11.00	13.00	-.12	-.11	120
Quantitative Concepts	14.00	14.00	14.00	-.48	-.47	120
Figure Classification	12.24	12.00	10.00	-.07	-.45	119
Matrices	12.10	12.00	12.00	.07	.22	119
Batteries						
Verbal Aptitude[a]	27.92	29.00	34.00	-.42	-.81	120
Quantitative Aptitude[b]	25.09	25.00	25.00	-.26	-.54	120
Non-Verbal Aptitude[c]	24.34	24.00	23.00	.07	-.29	119
Whole Test	77.48	79.00	67.00	-.21	-.79	119

Note. [a]= Oral Vocabulary + Verbal Reasoning;
[b]= Relational Concepts + Quantitative Concepts;
[c]= Figure Classification+ Matrices

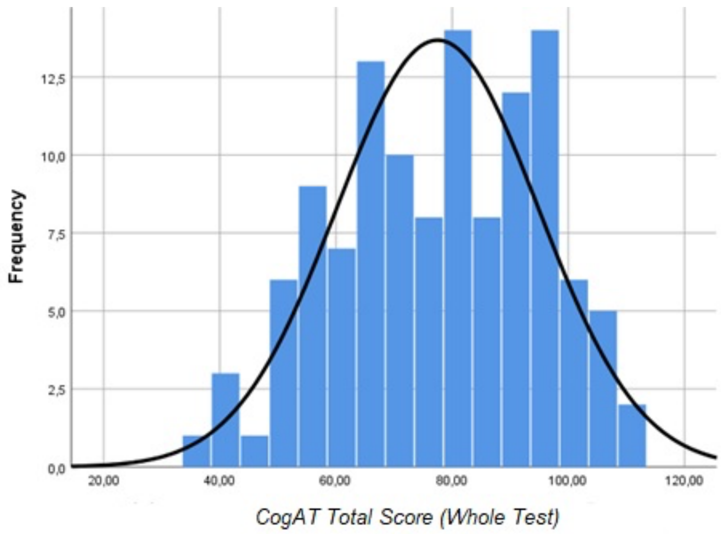

Figure 2. *Normal Distribution Curve for CogAT Total Test Score*

Research Ethics

Social and Human Sciences Ethics Committee Approval Certificate was given by Bartın University on 10.11.2022 with the Protocol Number 2022-SBB-0493.

FINDINGS

Descriptive Statistics for Total, Subtest and Battery Scores of the CogAT

The descriptive statistics of the subtests, ability levels and the whole of the CogAT of the children participating in the study are presented in Table 4.

Table 4. Descriptive Statistics for the Whole Sample

CogAT	*M*	*SD*	*Min.*	*Max.*	*Range*	*N*
Subtests						
Oral Vocabulary	15.22	3.48	6.00	20.00	14.00	120
Verbal Reasoning	12.70	3.62	5.00	20.00	15.00	120
Relational Concepts	11.09	3.53	1.00	19.00	18.00	120
Quantitative Concepts	14.00	4.01	2.00	20.00	18.00	120
Figure Classification	12.24	4.21	1.00	20.00	19.00	119
Matrices	12.10	3.22	3.00	20.00	17.00	119
Batteries						
Verbal Aptitude[a]	27.92	6.52	13.00	39.00	26.00	120
Quantitative Aptitude[b]	25.09	6.90	6.00	39.00	33.00	120
Non-Verbal Aptitude[c]	24.34	6.81	6.00	39.00	33.00	119
Whole Test	77.48	17.35	36.00	111.00	75.00	119

Notes. Possible score ranges (min-max): All subtest scores (0-20); Batteries (0-40) and CogAT Whole test score (0-120).

Upon scrutinizing Table 4, it can be discerned that, among the subtests of the CogAT, the subtest of Oral Vocabulary boasts the highest mean (M=15.22), whilst the subtest of Relational Concepts registers the lowest mean (M=11.09). With regard to the test batteries, the descending order of averages is as follows: Verbal Aptitude (M=27.92), Quantitative Aptitude (M=25.09), and Non-Verbal Aptitude (M=24.34). The Quantitative Concepts stands as the sole subtest where not a single student managed to answer all the questions, as evidenced by a maximum score of 19.00.

Overall, despite the absence of a universally accepted norm, the recorded averages for the subtests, ability levels, and overall scores of the CogAT appear to exceed the median level considering the maximum score that can be obtained from the test. Additionally, an inspection of the standard deviation values suggests a limited degree of deviation from the mean across all scores, thereby indicating a relative consistency in the performance of the participants.

Comparison of Children's CogAT Scores by Gender and School Type

In an effort to ascertain whether the Cognitive Abilities Test (CogAT) scores of the student participants, concerning the subtests, aptitude levels, and overall performance, significantly varied based on their gender and type of school, the Independent Groups t-Test was employed. The results derived from this statistical analysis are encapsulated within Tables 5 and 6, respectively.

Table 5. Comparison of S Children's CogAT scores according to gender

CogAT	Girls *(N=63)*		Boys *(N=57)*		*t*(117-118)	*p*	Cohen's *d*
	M	*SS*	*Ort.*	*SS*			
Subtests							
Oral Vocabulary	15.15	3.40	15.29	3.60	-2.180	.828	0.03
Verbal Reasoning	12.76	3.66	12.63	3.61	.196	.845	0.03
Relational Concepts	10.79	3.33	11.42	3.75	-.970	.334	0.17
Quantitative Concepts	13.93	4.03	14.07	4.03	-.181	.856	0.03
Figure Classification	11.77	3.80	12.75	4.60	-1.270	.207	0.23
Matrices	11.38	3.09	12.87	3.21	-2.576	.011**	0.47
Batteries							

Verbal Aptitude	27.92	6.47	27.92	6.62	-0.008	.994	0.00
Quantitative Aptitude	24.73	6.67	25.49	7.19	-.601	.549	0.10
Non-Verbal Aptitude	23.16	6.14	25.63	7.31	-2.000	.048*	0.36
Whole Test	76.04	16.69	79.05	18.05	-.943	.348	0.17

Notes. Figure Classification and Matrices subtests were administered to 119 children.
*$p < .05$. **$p < .01$.

Table 5 delineates the comparative analysis of children's CogAT scores based on gender. For each subtest and battery of the CogAT, the table outlines the mean scores, standard deviations, t-values, p-values, and effect sizes (Cohen's d) for girls (N=63) and boys (N=57). In examining the subtests, no significant differences were observed in the Oral Vocabulary, Verbal Reasoning, Relational Concepts, Quantitative Concepts, and Figure Classification subtests, as denoted by the non-significant p-values (>0.05) and negligible effect sizes (Cohen's d <0.2). However, in the Matrices subtest, boys scored significantly higher than girls, as reflected by the t-value of -2.576 and a significant p-value of 0.011, with a moderate effect size (Cohen's d = 0.47). Regarding the CogAT batteries, the Verbal and Quantitative Aptitudes demonstrated no significant differences between genders, with minimal effect sizes. On the other hand, in the Non-Verbal Aptitude, boys significantly outperformed girls, as indicated by the t-value of -2.000, a p-value of 0.048, and a small-to-moderate effect size (Cohen's d = 0.36). In terms of overall performance on the CogAT, the difference between boys and girls was not statistically significant, with a t-value of -0.943 and a p-value of 0.348. The effect size was small, indicating a limited practical significance (Cohen's d = 0.17).

Table 6. Comparison of Children's CogAT scores according to school type

CogAT	Preschool *(N=63)*		Primary School *(N=57)*		$t(118)$	p	Cohen's d
	Mean	*SD*	*Mean*	*SD*			
Subtests							
Oral Vocabulary	13.79	3.67	16.80	2.45	-5.223	.000*	0.96
Verbal Reasoning	11.12	3.25	14.43	3.21	-5.595	.000*	1.02
Relational Concepts	9.79	3.49	12.52	3.00	-4.566	.000*	0.83
Quantitative Concepts	12.60	4.15	15.54	3.25	-4.287	.000*	0.78
Figure Classification	10.58	4.01	14.05	3.68	-4.906	.000*	0.90
Matrices	11.19	3.24	13.08	2.92	-3.333	.001**	0.61
Batteries							
Verbal Aptitude	24.92	6.19	31.24	5.15	-6.047	.000*	1.10
Quantitative Aptitude	22.39	6.75	28.07	5.79	-4.911	.000*	0.90
Non-Verbal Aptitude	21.77	6.61	27.14	5.90	4.651	.000*	0.85
Whole Test	69.24	15.82	86.45	14.30	6.207	.000*	1.43

Notes. *Figure Classification and Matrices subtests were administered to 119 children.*

*p=.000, ***p = .001.

Upon examination of Table 6, the CogAT scores—across subtests, ability levels (batteries), and the overall test—of the participating children were observed to be significantly higher for the first graders compared to the preschoolers. The most significant effect size was observed in the CogAT's total test score, as indicated by the t-value of 6.207, the p-value of .000, and a substantial effect size (Cohen's d =1.43). This implies that the total test scores have the greatest influence on the divergence between the mean scores of first grade and preschool children.

In terms of subtests, the most pronounced effect size between first grade and preschool children was seen in the Verbal Reasoning subtest, denoted by the t-value of 5.595, p-value of .000, and a large effect size (Cohen's d =1.02). Similarly, among the ability levels (batteries), the Verbal Aptitude battery displayed the largest effect size between the two student groups, as signified by the t-value of -6.047, the p-value of .000, and a considerable effect size (Cohen's d =1.10). In general, it can be concluded that as grade level increases, so too do the CogAT scores, thereby indicating the validity of the test with respect to this variable.

Comparison of Children's CogAT Scores According to Age Groups

The results of a One-way Analysis of Variance (ANOVA), conducted to determine whether there is a significant disparity in the CogAT scores—both at the battery level and in totality—based on different age groups of the participating children, are delineated in Table 7.

Table 7. One-way ANOVA Results According to Age Groups

CogAT	Age Group	*M*	*SD*	*N*	*F*	*p*	η^2	*Difference*
Verbal Aptitude	*1.* 60-66 months	24.97	6.63	39				
	2 .67-72 months	25.72	5.96	25	14.02	.000*	.19	1<2<3
	3. 77-84 months	30.96	5.31	56				
Quantitative Aptitude	*1.* 60-66 months	22.12	7.09	39				
	2 .67-72 months	23.16	6.38	25	11.24	.000*	.16	1<2<3
	3. 77-84 months	28.01	5.82	56				
Non-Verbal Aptitude	*1.* 60-66 months	22.28	7.31	38				
	2 .67-72 months	21.12	5.34	25	10.94	.000*	.15	2<1<3
	3. 77-84 months	27.17	5.94	56				
Whole Test	*1.* 60-66 months	69.63	17.03	38				
	2. 67-72 months	70.00	14.52	25	16.74	.000*	.22	1<2<3
	3. 77-84 months	86.16	14.62	56				

Note. Tukey post-hoc tests (α = 0.05) were performed to identify differences.
∗ indicates *p* = .000.

Upon scrutiny of Table 7, the One-way Analysis of Variance (ANOVA) demonstrates a statistically significant variance among the groups with regards to Verbal Aptitude scores (F=14.02, p<.001, partial $\eta 2$ =.19). Post-hoc comparisons using the Tukey HSD test revealed that the group aged 77-84 months (M=30.96, SD=5.31) significantly outperformed both the 67-72 months group (M=25.72, SD=5.96) and the 60-66 months group (M=24.97, SD=6.63) in terms of Verbal Aptitude scores. Moreover, the 67-72 months group showed higher scores than the 60-66 months group. A large effect size was indicated by the partial eta squared ($\eta 2$) analysis.

Quantitative Aptitude scores also presented a statistically significant difference among the groups, as revealed by the One-way ANOVA (F=10.94, p<.001, partial $\eta 2$ =.15). Subsequent post-hoc analysis using the Tukey HSD test indicated that the 77-84 months group (M=28.01, SD=5.82) had significantly higher scores compared to both the 67-72 months group (M=23.16, SD=6.38) and the 60-66 months group (M=22.12, SD=7.09). In addition, the 67-72 months group exhibited higher scores than the 60-66 months group. The actual difference between the groups, as indicated by the partial eta squared ($\eta 2$), is large.

When evaluated in terms of Non-Verbal Aptitude scores, the One-way ANOVA displayed a statistically significant discrepancy among the groups (F=11.24, p<.001, partial $\eta 2$ =.16). The Tukey HSD test determined that the 77-84 months group (M=27.17, SD=5.94) scored significantly higher than both the 67-72 months group (M=21.12, SD=5.34) and the 60-66 months group (M=22.28, SD=7.31). Interestingly, the 60-66 months group demonstrated higher scores than the 67-72 months group, contradicting the general pattern observed. A large effect size is identified by the partial eta squared (η^2) analysis.

Lastly, in terms of the total CogAT score, the One-way ANOVA revealed a statistically significant divergence among the groups (F=16.74, p<.001, partial $\eta 2$ =.22). The post-hoc comparisons indicated that the 77-84 months group (M=86.16, SD=14.62) significantly exceeded both the 67-72 months group (M=70.00, SD=14.52) and the 60-66 months group (M=69.63, SD=17.03) in total CogAT score. Furthermore, the 67-72 months group had a higher total CogAT score than the 60-66 months group. The partial eta squared ($\eta 2$) analysis suggests a quite large actual difference among the groups.

Comparison of Children’s CogAT Scores According to Parents' Level of Education

The results of the One-way Analysis of Variance (ANOVA), conducted to ascertain if a significant difference exists among the scores of children participating in the study with respect to the batteries and overall CogAT in accordance with the parental education level, are delineated in Tables 8 and 9, respectively.

Table 8. One-way ANOVA Results According to Mother's Level of Education

CogAT	Mother's Level of Education	*M*	*SD*	*N*	*F*	*p*	η^2	*Difference*
Verbal Aptitude	*1*. Below high school	24.22	6.19	18	2.686	.035*	.09	1<4
	2. High School	26.34	6.80	23				
	3. Associate degree	27.35	6.44	14				
	4. Bachelor's	29.60	5.88	43				
	5. Postgraduate	28.70	6.89	10				
Quantitative Aptitude	*1*. Below high school	22.33	5.13	18	2.133	.082		
	2. High school	23.34	7.67	23				
	3. Associate degree	24.28	7.81	14				
	4. Bachelor's	26.95	5.54	43				
	5. Postgraduate	24.00	8.21	10				
Non-Verbal Aptitude	*1*. Below high school	21.77	6.75	18	1.020	.401		
	2. High School	23.63	7.20	22				
	3. Associate degree	24.00	7.20	14				
	4. Bachelor's	25.37	6.68	43				
	5. Postgraduate	22.70	6.03	10				
The Whole Test	*1*. Below high school	68.33	15.89	18	2.333	.061		
	2. High school	73.86	18.87	22				
	3. Associate degree	75.64	19.42	14				
	4. Bachelor's	81.93	14.96	43				
	5. Postgraduate	75.40	17.65	10				

Note*.* Tukey post-hoc tests (α = 0.05) were performed to identify differences. * indicates $p < .05$

Upon scrutinizing Table 8, the results of the one-way Analysis of Variance (ANOVA) disclosed a statistically significant discrepancy solely in the Verbal Aptitude scores amongst groups, contingent upon the education level of the mother, F=2.686, p<.05; partial $\eta 2$ =.09. The post-hoc Tukey HSD test, carried out to ascertain the origin of this divergence, highlighted that the Verbal Aptitude scores of children with mothers possessing a bachelor's degree (M=29.90, SD=5.88) were significantly elevated compared to those whose mothers' education terminated before high school (primary or secondary school) (M=14.22, SD=6.19). The assessment of the partial eta squared ($\eta 2$) value suggests that the actual difference between these groups manifests at a moderate level. No significant variances were discerned among the remaining groups.

Table 9. One-way ANOVA Results According to Father's Education Level

CogAT	Father's Level of Education	*M*	*SD*	*N*	*F*	*p*	η^2	*Difference*
Verbal Aptitude	*1*. Below high school	22.77	7.39	9	2.868	.027*	.10	1<4, 1<5
	2. High School	26.60	6.82	23				
	3. Associate degree	26.50	4.16	12				
	4. Bachelor's	28.96	6.12	52				
	5. Postgraduate	30.66	6.45	12				
Quantitative Aptitude	*1*. Below high school	20.44	6.18	9	3.807	.006**	.12	3<4
	2. High school	23.82	5.89	23				
	3. Associate degree	20.75	4.00	12				
	4. Bachelor's	26.75	7.16	52				
	5. Postgraduate	26.83	6.19	12				
Non-Verbal Aptitude	*1*. Below high school	21.77	7.74	9	3.020	.021*	.10	3<4
	2. High School	22.30	7.15	23				
	3. Associate degree	19.81	3.76	11				
	4. Bachelor's	26.09	6.77	52				
	5. Postgraduate	24.08	5.99	12				
The Whole Test	*1*. Below high school	65.00	19.94	9	3.718	.007**	.12	1<4
	2. High school	72.73	17.09	23				
	3. Associate degree	67.90	9.19	11				
	4. Bachelor's	81.80	17.17	52				
	5. Postgraduate	81.58	14.95	12				

Note. Tukey post-hoc tests (α = 0.05) were performed to identify differences. * indicates $p < .05$, ** indicates $p < .01$, Upon examining Table 9, the outcomes of the one-way ANOVA revealed a statistically significant distinction solely in the Verbal Aptitude scores among children, concerning the educational attainment of their fathers, F=2.868, p<.05; partial $\eta 2$ =.10. Subsequent post hoc comparisons using the Tukey HSD test indicated that the Verbal Aptitude scores of children with fathers holding an undergraduate degree (M=28.96, SD=6.18) and a graduate degree (M=30.66, SD=6.45) were significantly higher than those of children whose fathers' education terminated before high school (primary or secondary school) (M=22.77, SD=77.39). The partial eta squared ($\eta 2$) value suggests that the actual difference between these groups is at a moderate level. No significant variances were discerned among the other groups.

Moreover, the findings of the one-way ANOVA indicated a statistically significant discrepancy in the Quantitative Aptitude scores of children based on their father's education level, F=3.807, p<.01; partial $\eta 2$ =.12. The post hoc Tukey HSD test further revealed that children whose fathers possessed an undergraduate degree (M=26.75, SD=7.16) exhibited significantly higher Quantitative Aptitude scores compared to those whose fathers held an associate degree (M=20.75, SD=4.00). The analysis of partial eta squared ($\eta 2$) suggests that the actual difference between these groups is at a moderate level. No significant variances were observed among the remaining groups.

Similarly, the outcomes of the one-way ANOVA indicated a statistically significant distinction in the Non-Verbal Aptitude scores among children, dependent on their father's education level, F=3.020, p<.05; partial $\eta 2$ =.12. The post hoc Tukey HSD test demonstrated that children with fathers possessing a bachelor's degree (M=26.09, SD=6.77) achieved significantly higher Non-Verbal Aptitude scores compared to those with fathers holding an associate degree (M=19.81, SD=3.76). The analysis of partial eta squared ($\eta 2$) indicates that the actual difference between these groups is at a moderate level. No significant variances were observed among the other groups.

Lastly, upon examining Table 9, the one-way ANOVA disclosed a statistically significant distinction in the cognitive abilities total test scores of children in relation to their father's education level, F=3.718, p<.01; partial $\eta 2$ =.12. The subsequent post hoc Tukey HSD test revealed that the cognitive abilities total test scores of children whose fathers attained an undergraduate degree (M=81.80, SD=17.17) were significantly higher than those of children whose fathers held an associate degree (M=65.00, SD=19.94). The analysis of partial eta squared ($\eta 2$) suggests that the actual difference between these groups is at a moderate level. No significant variances were observed among the other groups.

DISCUSSION AND CONCLUSION

In this study, the investigation of cognitive abilities among 60-72-month-old children in terms of gender, school type, age group, and parental education level yielded interesting findings. While no significant gender difference was observed in the overall test scores, boys exhibited better performance in matrices and Non-Verbal Aptitude scores. The absence of a gender effect in the overall test scores aligns with previous research that has reported mixed findings regarding cognitive gender differences (Lohman & Lakin, 2009; Strand et al., 2006). These inconsistencies suggest that cognitive abilities may be influenced by a complex interplay of biological, social, and environmental factors. Furthermore, the gender-specific advantages observed in matrices and Non-Verbal Aptitude scores are consistent with prior studies highlighting distinct cognitive strengths in different domains for males and females (Maitland et al., 2000; Schaie & Hertzog, 1983;). These results emphasize the importance of considering specific cognitive domains when examining gender differences in cognitive abilities.

The significant difference in cognitive abilities favoring primary school children provides evidence for the sensitivity of the CogAT Form-6 to grade level and school type among Turkish children. This finding supports the notion that cognitive abilities undergo developmental changes and highlights the importance of assessing cognitive abilities at different stages of development (Demetriou et al., 2020). The inclusion of preschool education experiences in this study adds value by acknowledging the potential influence of early education on cognitive skills. The finding that children who attended preschool education exhibited higher cognitive ability test scores further emphasizes the positive impact of early educational interventions on cognitive development (Glick, & Sahn, 2007).

Examining the relationship between cognitive abilities and age groups revealed a significant increase in total test scores with increasing age. These results align with the existing literature on age-related changes in cognitive abilities, highlighting the dynamic nature of cognitive development across different developmental stages (Christoforides et al., 2016; Demetriou et al., 2017, 2018; Makris et al., 2017). The cognitive abilities exhibited by children in this study are consistent with the expected cognitive milestones at their respective age groups. These findings underscore the importance of understanding the unique cognitive demands and abilities associated with each developmental stage and provide valuable insights into the developmental trajectories of cognitive abilities.

The investigation of parental education level's impact on cognitive abilities revealed significant associations between higher parental education levels and superior cognitive performance in children. Specifically, maternal education level exerted a significant influence on children's Verbal Aptitude scores, while paternal education level impacted children's verbal, numerical, Non-Verbal Aptitude, and overall test scores. These findings align with previous research highlighting the intergenerational transmission of cognitive abilities and the influence of parental education on children's cognitive development (Anger & Heineck, 2010; Villaseñor et al., 2009). The significant impact of maternal education on children's Verbal Aptitude scores may be attributed to the linguistic and cognitive stimulation provided by mothers during early childhood. On the other hand, the influence of paternal education on multiple cognitive domains suggests the importance of paternal involvement in fostering children's cognitive abilities. The increasing involvement of fathers in child-rearing activities, as observed in contemporary society, may contribute to their influence on children's cognitive development (Mercan & Şahin, 2017).

Overall, this study contributes to the existing literature by examining the cognitive abilities of children in relation to various factors. The findings highlight the complexities of cognitive gender differences, the developmental trajectory of cognitive abilities, and the role of parental education in shaping children's cognitive performance. The results underscore the importance of considering multiple factors, including gender, age, school type, and parental education, in understanding the multidimensional nature of cognitive abilities.

Implications, Future Directions, and Limitations

The findings of this study have important implications for both research and practice. Firstly, it highlights the significance of assessing children's cognitive abilities at specific periods and tracking their development from the preschool years onward. This emphasizes the importance of early intervention programs that target children with below-grade level cognitive development. Furthermore, curricula should be designed to enhance children's cognitive abilities, considering the impact of such abilities on overall development.

Additionally, recognizing the influential role of parents in their children's cognitive development, it is recommended to implement more effective family education activities. By raising parental awareness, parents can actively contribute to fostering their children's cognitive abilities.

However, it is crucial to acknowledge the limitations of this study. One notable limitation is the relatively small sample size, which restricts the generalizability of the findings. To overcome this limitation, future research should aim for larger and more diverse samples to ensure more robust conclusions.

Based on the findings, several recommendations can be made for future research and practice:

Regular monitoring of children's cognitive abilities using standardized tests should be implemented from early childhood to detect and address any developmental gaps promptly.

Parental involvement and education should be emphasized, with efforts aimed at increasing awareness of their impact on children's cognitive development. Expanding family education activities can effectively support this objective.

Early intervention programs should be tailored to target cognitive abilities specifically, addressing the needs of children with developmental delays.

Future research can explore the longitudinal and cross-sectional effects of the Verbal, Quantitative, and Non-Verbal dimensions of the *CogAT* Form-6 on the academic achievement of Turkish children.

Large-scale studies should investigate the influence of socio-economic status and cultural differences on children's cognitive abilities, providing valuable insights into the broader context of cognitive development.

Conclusion

The findings of this study revealed that there was no significant disparity in cognitive abilities among participants based on gender, as indicated by the total scores. However, when examining specific subtests and batteries, boys outperformed girls significantly in the matrices subtest and Non-Verbal Aptitude. Furthermore, a noteworthy discrepancy was observed based on the type of school, favoring first graders over children attending pre-school education institutions. Overall, the study observed a positive correlation between age group and both battery and total test scores, indicating that as the age group increased, cognitive performance improved. Another significant factor influencing cognitive abilities was the educational level of the parents. Children whose mothers held a bachelor's degree achieved significantly higher Verbal Aptitude scores compared to children whose mothers had less than a high school education (primary or secondary school). Similarly, it was noted that cognitive abilities tended to increase as the level of the father's education rose, with a few exceptions.

Statements of Publication Ethics

Publication ethics statements were complied with in the study.

Researchers' Contribution Rate

Authors	Literature review	Method	Data Collection	Data Analysis	Results	Conclusion
Author 1	⊠		⊠		⊠	⊠
Author 2	⊠		⊠		⊠	⊠
Author 3	⊠	⊠	⊠	⊠	⊠	⊠

Conflict of Interest

There is no conflict of interest in the study.

REFERENCES

Aiello, M. (2002). *Spatial reasoning: theory and practice.* Dissertation Thesis, Institute for Logic, Language and Computation, Amsterdam University, Amsterdam, Holland.

Akşin Yavuz, E. (2016). *Reliability and validity study of application of cognitive functions scale and analysis od cognitive functions of 48-66 months-old children.* Dissertation Thesis, Marmara University, İstanbul, Turkey.

Alp, E. İ. & Diri, A. (2003). A validation study of CogAT® for Turkish kindergarten and grade 1 students. *Turkish Journal of Psychology, 18*(51), 19-31. https://psycnet.apa.org/record/2003-99205-002

Anger, S., & Heineck, G. (2010). Do smart parents raise smart children? The intergenerational transmission of cognitive abilities. *Journal of population Economics, 23*, 1105-1132. http://dx.doi.org/10.2139/ssrn.1350259

Ardila, A., & Bernal, B. (2007). What can be localized in the brain? Toward a "factor" theory on brain organization of cognition. *International Journal of Neuroscience*, *117*(7), 935-969. https://doi.org/10.1080/00207450600912222

Arslan, D. (2018). *The relationship between middle school student's humor production ability and intelligence measured through the ASIS.* Dissertation Thesis, Anadolu University, Eskişehir, Turkey.

Avcı Doğan, G. (2022). *Development of the mental speed test for children*. Dissertation Thesis, Anadolu University, Eskişehir, Turkey.

Bernal, R. (2008). The effect of maternal employment and childcare on children's cognitive development. *International Economic Review, 49*(4), 1173-1209. https://www.jstor.org/stable/20486836

Bickley, P. G., Keith, T. Z., & Wolfle, L. M. (1995). The three-stratum theory of cognitive abilities: Test of the structure of intelligence across the life span. *Intelligence, 20*(3), 309-328. https://doi.org/10.1016/0160-2896(95)90013-6

Bildiren, A., Kargın, T., & Korkmaz, M. (2017). Reliability and validity of colored progressive matrices for 4-6 age children. *Talent, 7*(1), 19-37. https://theeducationjournals.com/index.php/talent/article/view/52/46

Broberg, A. G., Wessels, H., Lamb, M. E., & Hwang, C. P. (1997). Effects of day care on the development of cognitive abilities in 8-year-olds: A longitudinal study. *Developmental Psychology, 33*(1), 62. https://doi.org/10.1037//0012-1649.33.1.62

Büyüköztürk, Ş. (2021). *Sosyal bilimler için veri analizi el kitabı* (29. Baskı). *[Manual of data analysis for social sciences (29th ed.)]* Ankara: Pegem Akademi.

Büyüköztürk, Ş., Kılıç Çakmak, E., Akgün, Ö.A., Karadeniz, Ş., & Demirel, F. (2022*). Eğitimde Bilimsel Araştırma Yöntemleri* (32. Baskı). *[*Scientific Research Methods in Education (*32nd ed.*)*]* Ankara: Pegem Akademi.

Cattell, R. B. (1967). The theory of fluid and crystallized general intelligence checked at the 5-6 year old level. *British Journal of Educational Psychology, 37*(2), 209-224. https://doi.org/10.1111/j.2044-8279.1967.tb01930.x

Christoforides, M., Spanoudis, G., & Demetriou, A. (2016). Coping with logical fallacies: A developmental training program for learning to reason. *Child Development*, 87, 1856–1876. https://www.jstor.org/stable/44250041

Cocodia, E. A. (2014). Cultural perceptions of human intelligence. *Journal of Intelligence*, 2(4), 180-196. https://doi.org/10.3390/jintelligence2040180

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. New York: Erlbaum.

Daniel, M. H. (1997). Intelligence testing: Status and trends. *American Psychologist, 52*(10), 1038-1045. https://doi.org/10.1037/0003-066X.52.10.1038

Daseking, M., Petermann, F., & Waldmann, H. C. (2017). Sex differences in cognitive abilities: Analyses for the German WAIS-IV. *Personality and Individual Differences, 114*, 145-150. https://doi.org/10.1016/j.paid.2017.04.003

Demetriou, A., Kazali, E., Kazi, S., & Spanoudis, G. (2020). Cognition and cognizance in preschool predict school achievement in primary school. *Cognitive Development*, 54, https://doi.org/10.1016/j.cogdev.2020.100872

Demetriou, A., Makris, N., Kazi, S., Spanoudis, G., & Shayer, M. (2018). The developmental trinity of mind: Cognizance, executive control, and reasoning. *WIREs Cognitive Science*, *4*(9). https://doi.org/10.1002/wcs.1461

Demetriou, A., Spanoudis, G., Kazi, S., Mouyi, A., Žebec, M. S., Kazali, E., et al. (2017). Developmental differentiation and binding of mental processes with remorphing g through the life-span. *Journal of Intelligence*, 5(23), https://doi.org/10.3390/jintelligence5020023.

Dündar, S. (2019). *The effects of cultural intelligence and emotional intelligence on leadership types*. Master's thesis, İstanbul Sabahattin Zaim University, İstanbul, Turkey.

Erinç, Y. (2022). *The effect of mind and intelligence games activities on block based programming learning.* Master's thesis, Balıkesir University, Balıkesir, Turkey.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research in education.* Unites States: McGraw Hill.

Fry, A. F., & Hale, S. (2000). Relationships among processing speed, working memory, and fluid intelligence in children. *Biological Psychology*, *54*(1-3), 1-34. https://doi.org/10.1016/S0301-0511(00)00051-X

George D. & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference* (4th ed.). Boston: Allyn and Bacon.

Glick, P. & Sahn, D. (2007). Cognitive Skills Among Children in Senegal: Disentangling the Roles of Schooling and Family Background. *Public Economics eJournal,* 121, 1-29. DOI:10.2139/ssrn.832145

Green, S. B. & Salkind, N. J. (2005). *Using SPSS for Windows and Macintosh: Analyzing and understanding data*. Upper Saddle River, NJ: Pearson/Prentice Hall.

Guilford, J. P. (1967). *The nature of human intelligence*. New York: McGraw-Hil.

Gustafsson, J. E. (2008). Effects of international comparative studies on educational quality on the quality of educational research. *European Educational Research Journal*, 7(1), 1-17. https://doi.org/10.2304/eerj.2008.7.1.1

Halpern, D. F. (2004). A cognitive-process taxonomy for sex differences in cognitive abilities. *Current directions in psychological science, 13*(4), 135-139. https://doi.org/10.1111/j.0963-7214.2004.00292.x

Heit, E., & Rotello, C. M. (2010). Relations between inductive reasoning and deductive reasoning. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 36(3), 805. https://doi.org/10.1037/a0018784.

Horn, J. L. (1985). Remodeling old models of intelligence. B. B. Wolman (Ed.), *Handbook of intelligence* in (pp. 267-300). New York: Wiley.

Horn, J. L., & McArdle, J. J. (2007). Understanding human intelligence since Spearman. In Factor analysis at 100 (pp. 219-262). Routledge.

İnal, G., & Ömeroğlu, E. (2011). The study of validity and reliability test of cognitive abilities test form 6 for 61-72 month old children. *The Journal of Theoretical Educational Science, 4*(2), 198-207

İnci, G., (2021). From galton to the present: Intelligence theories. *ODÜSOBİAD 11*(3), 1053-1068. https://doi.org/10.48146/odusobiad.996062

Kaur, G., Awasthy, S., & Syed, U. G. (2019). Effect of critical thinking on cognitive enhancement. *Defence Life Science Journal, 4*(2), 117-121. https://doi.org/10.14429/dlsj.4.13201

Kaufman, J. C. (2012). Counting the muses: development of the Kaufman domains of creativity scale (K-DOCS). *Psychology of Aesthetics, Creativity, and the Arts,* 6(4), 298. https://psycnet.apa.org/buy/2012-27364-001

Kavcar, B. (2011). *The relationship between emotional intelligence and academic achievement and some demographical variables: A study on a state university.* Dissertation Thesis, Ankara University, Ankara, Turkey.

Korkman, H. (2020). *Zeka ve Yükleme Karmaşıklığı [*Intelligence and Installation Complexity*].* İksad Publishing House. Ankara: Turkey.

Kubinger, K. D., Litzenberger, M., & Mrakotsky, C. (2006). Practised intelligence testing based on a modern test conceptualization and its reference to the common intelligence theories. *Learning and Individual Differences*, *16*(2), 175-193. https://doi.org/10.1016/j.lindif.2005.08.001

Lakin, J. M., & Gambrell, J. L. (2014). Sex differences in fluid reasoning: Manifest and latent estimates from the cognitive abilities test. *Journal of Intelligence, 2*(2), 36-55. https://doi.org/10.3390/jintelligence2020036

Lohman, D. F. & Hagen, E. (2003). *Interpretive guide for teachers and counselors: Cognitive Abilities Test Form-6 All Levels.* Itasca, Illinois: Riverside Publishing

Lohman, D. F., & Lakin, J. M. (2009). Consistencies in sex differences on the Cognitive Abilities Test across countries, grades, test forms, and cohorts. *British Journal of Educational Psychology, 79*(2), 389-407. https://doi.org/10.1348/000709908X354609

Maitland, B. S., Intrieri, C. R., Schaie, W. K. &. Willis, S. L. (2000). Gender differences and changes in cognitive abilities across the adult life span. *Aging, Neuropsychology and Cognition, 7*(1), 32-53. https://doi.org/10.1076/anec.7.1.32.807

Makris, N., Tachmatizdis, D., Demetriou, A., & Spanoudis, G. (2017). Mapping the evolving core of intelligence: Changing relations between executive control, reasoning, language, and awareness. *Intelligence*, 62, 12-30. https://doi.org/10.1016/j.intell.2017.01.006.

Mercan, Z. (2021). Studies on early childhood reasoning skills in Turkey. *Journal of Muallim Rıfat Faculty of Education, 3*(2), 104-120.

Mercan, Z., & Şahin, F. T. (2017). The father's role and the father's role perception in different cultures. *International Journal of Early Childhood Education Studies*, *2*(2), 1-10.

Neisser, U., Boodoo, G., Bouchard, T. J., Jr., Boykin, A. W., Brody, N., Ceci, S. J., Halpern, D. E., Loehlin, J. C., Perloff, R., Sternberg, R. J., & Urbina, S. (1996). Intelligence: Knowns and unknowns. *American Psychologist, 51*(2), 77–101. https://doi.org/10.1037/0003-066X.51.2.77

Oktay, S. (2019). *Predictive power of fluid intelligence to personality traits.* Master's thesis, Aydın Adnan Menderes University, Aydın, Turkey.

Otero, I., Salgado, J. F., & Moscoso, S. (2022). Cognitive reflection, cognitive intelligence, and cognitive abilities: A meta-analysis. *Intelligence, 90*, 101614. https://doi.org/10.1016/j.intell.2021.101614

Palejwala, M. H., & Fine, J. G. (2015). Gender differences in latent cognitive abilities in children aged 2 to 7. *Intelligence, 48*, 96-108. https://doi.org/10.1016/j.intell.2014.11.004

Patterson, J. S. (2012). *Predicting sat performance from advanced course content and timing of matriculation*. Dissertation thesis, Mercer University, Atlanta.

Rohde T. E., & Thompson L. A. (2007). Predicting academic achievement with cognitive ability. *Intelligence, 35*, 83-92. https://doi.org/10.1016/j.intell.2006.05.004

Schady, N. (2011). Parents' education, mothers' vocabulary, and cognitive development in early childhood: Longitudinal evidence from ecuador. *American Journal of Public Health*, *101*(12), 2299-2307. https://doi.org/10.2105/AJPH.2011.300253

Schaie, K. W., & Hertzog, C. (1983). Fourteen-year cohort-sequential analyses of adult intellectual development. *Developmental Psychology, 19*, 531- 543. https://doi.org/10.1037/0012-1649.19.4.531

Schipolowski, S., Wilhelm, O., & Schroeders, U. (2014). On the nature of crystallized intelligence: The relationship between verbal ability and factual knowledge. *Intelligence*, 46, 156-168. https://doi.org/10.1016/j.intell.2014.05.014

Sözel, H. K. (2017). *A study on the distinctiveness validity of the Anadolu-Sak Intelligence Scale (ASİSİ) among groups of special education*. Doctoral dissertation, Anadolu University, Eskişehir, Turkey.

Spinath B., Spinath F. M., Harlaar N., & Plomin R. (2006). Predicting school achievement from general cognitive ability, self-perceived ability, and intrinsic value. *Intelligence, 34*, 363-374. https://doi.org/10.1016/j.intell.2005.11.004

Strand, S., Deary, I. J., & Smith, P. (2006). Sex differences in cognitive abilities test scores: A UK national picture. *British Journal of Educational Psychology, 76*(3), 463-480. https://doi.org/10.1348/000709905X50906

Tamul, Ö. F. (2017). *A social validity and reliability study of Anadolu-Sak Intelligence Scale (ASİS)*. Doctoral dissertation, Anadolu University, Eskişehir, Turkey.

Tillman, C. M., Bohlin, G., Sørensen, L., & Lundervold, A. J. (2009). Intelligence and specific cognitive abilities in children. *Journal of Individual Differences*, 30(4), 209-219. https://doi.org/10.1027/1614-0001.30.4.209

Vernonn, P. E. (1961). *The structure of human intelligence*. (2nd edition). London: Methuen

Villaseñor, E., Martín, A., Díaz, E., Rosselli, M., & Ardila, A. (2009). Effects of parents' educational level, school type and gender on the development of attention and memory. *Revista Latinoamericana de Psicología*, 41(2), 257-276. http://www.scielo.org.co/scielo.php?pid=S0120-05342009000200007&script=sci_abstract&tlng=en

Weiss, S., Steger, D., Kaur, Y., Hildebrandt, A., Schroeders, U., & Wilhelm, O. (2021). On the trail of creativity: Dimensionality of divergent thinking and its relation with cognitive abilities, personality, and insight. *European Journal of Personality, 35*(3), 291-314. https://doi.org/10.1002/per.2288

Yılmazçetin, Ş. (2021). *A study of relations between emotional intelligence, social intelligence, cultural intelligence and entrepreneurship tendency: A research on university students.* İstanbul University, İstanbul, Turkey.

Zimmerman, C. (2000). The development of scientific reasoning skills. *Developmental review*, *20*(1), 99-149. https://doi.org/10.1006/drev.1999.0497