



## Intelligence Differences across Years: A Trend Analysis

### Yıllara Göre Zeka Farklılıkları: Trend Analizi

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**ABSTRACT:** The Flynn effect, which advocated that there was a rise in the global IQ score, was widely accepted by the relevant scientific community. However, there are recent research findings that this effect has been reversed. In this study, both Flynn and anti-Flynn effects were investigated. The purpose of this study is to analyze students' general, verbal, and visual intelligence score trends in the last six years (range = 2016–2021). The participants of the study included 2192 students who were in first grade in elementary school by the time of data collection. The Anadolu-Sak Intelligence Scale (ASIS) was used to measure the full-scale IQ, verbal IQ, and visual IQ scores of the participants. Participants' mean general, verbal, and visual intelligence scores in different years were analyzed by trend analysis. The research findings showed that there was a descending trend in general, verbal, and visual scores between the years 2016 to 2021. Moreover, our findings reveal that there is a sharp decrease in IQ score trends between 2020 and 2021. Because of this study, the Flynn effect could not be seen in the way that was predicted.

**Keywords:** Intelligence, Flynn effect, trend analysis, full scale IQ.

**ÖZ:** Global IQ puanında bir artış olduğunu belirten Flynn etkisi, ilgili bilim alanında genel olarak kabul görmüştür. Ancak son yıllarda global IQ puanında bir düşüş olduğu görüşü yaygınlaşmıştır. Bu çalışmada Flynn ve anti-Flynn etkisi görüşleri araştırılmıştır. Çalışmanın amacı, öğrencilerin son 6 yıldaki (2016-2021) genel zekâ, sözel zekâ ve görsel zekâ puanlarının trendini analiz etmektir. Araştırmanın katılımcılarını 2192 ilkökul birinci sınıf öğrencisi oluşturmaktadır. Katılımcıların genel, sözel ve görsel zekâ puanlarını ölçmek için Anadolu-Sak Zekâ Ölçeği (ASIS) kullanılmıştır. Farklı yıllardaki genel, sözel ve görsel zekâ puan ortalamaları trend analizi ile karşılaştırılmıştır. Araştırma bulguları, 2016-2021 yılları arasında sözel ve görsel puanların trendinde aşağı doğru bir yön olduğunu göstermiştir. Özellikle 2020 ve 2021 yılları arasında zekâ puan ortalamalarında daha fazla bir düşüş olduğu görülmüştür. Bu çalışmada Flynn etkisinin yordamaları gözlenmemiştir.

**Anahtar kelimeler:** Zekâ, Flynn etkisi, trend analiz, toplam IQ.

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In its broadest meaning, intelligence can be defined as mental capacity, which includes reasoning, problem-solving, comprehension, or the ability to learn (Gottfredson, 1997). This list could be shortened or extended. The definition of intelligence is subject to change based on the theoretical standpoint of one. Though it is a grey concept, researchers have tried to measure it with their utmost valid tools since the earlier forms of the intelligence quotient (IQ) structure. One of the first tools for measuring intelligence was developed in the early 20<sup>th</sup> century (see Binet & Simon, 1905). Researchers have developed the modern IQ formula after experiencing measuring errors (Stern, 1912). The structure has continuously improved with such fast and analytical updates. Although not much time has passed since its first days, we use this concept in every part of our lives. Today, intelligence testing is used as a utility for educational, clinical, or even legal issues. Boring (1961) criticized the use of intelligence and intelligence testing because the ordinary connotation of intelligence was much broader. Despite its widespread use, the measurement of intelligence remains controversial. Aside from its usefulness, its impact on one's life cannot be underestimated. IQ and its use are strongly related to educational, occupational, economic, and social outcomes (Gottfredson, 1997). For the IQ concept to work, it is essential to talk about such important things in terms of the time factor.

One of the concepts suggested for the cumulative aspect of IQ is the Flynn effect. Throughout most of the twentieth century, a number of prominent researchers showed that scores on intelligence test scores increased significantly. This increase was explained by the Flynn effect, which claimed there was a global rise in the IQ score (Dutton et al., 2016). This phenomenon has significant implications because it might help us to discuss the role of heritability or environments in evaluating one's cognitive capacity in the context (Hiscock, 2007). This effect might also be observed in developing countries such as China, Dominica, Kenya, Saudi Arabia, Sudan, and Turkey (see Flynn, 2012). On the other hand, many researchers (Dutton & Lynn, 2015; Pietschnig & Voracek, 2015; Shayer & Ginsburg, 2009; Shayer et al., 2007; Woodley & Meisenberg, 2013) have found that intelligence test scores have gone down in the last decades of the 20th century. On the other hand, numerous researchers have found a decrease in the scores on intelligence tests in the latter decades of the twentieth century (Dutton & Lynn, 2015; Pietschnig & Voracek, 2015; Shayer & Ginsburg, 2009; Shayer et al., 2007; Woodley & Meisenberg, 2013).

"Flynn effect" was first reported in his 1984a study by James R. Flynn (1934-2020). This effect refers to the rise over time in standardized intelligence test scores. In his research, Flynn found a 13,8-point increase in IQ scores between 1932 and 1978 in America. The rise in IQ scores per year was calculated as 0.3 points. The increase in IQ scores per decade was estimated at approximately 3 points. The study sample included the standardization samples of successive versions of the Stanford-Binet (SB) and Wechsler intelligence tests.

Subsequent studies pointed out that these initial findings were also seen in the scores of various intelligence tests (Flynn, 1987). One of the most comprehensive studies on this subject was Flynn's cross-country meta-analysis study (1987). Within the scope of this study, he combined and compared the findings of a great deal of research conducted in 14 countries (i.e., Netherlands, Belgium, France, Norway, New Zealand, Canada, Germany, England, Australia, and Japan) between the years of 1950 and 1987.

In these studies, many verbal and non-verbal tests such as the Wechsler tests (Wechsler, 1949), SB (Terman & Merrill, 1960), Otis Test (Otis & Lennon, 1967), Iowa Basic Skills Test (Lindquist & Hieronymus, 1955), Raven Progressive Matrix (Raven, 1960) were used. Flynn (1987) observed that the results obtained from this study were entirely consistent with his previous research. The rise in the global intelligence scores was between 5 and 25 points, and the average was 15 points. There were significant differences in the rate of increase in IQ scores according to age groups or countries. Research findings showed that a significant increase was almost universal. Taking everything into account, the Flynn effect asserts that a person will get a lower IQ score on a current version of an intelligence test than on earlier versions of the test.

There are significant differences in the causes of the Flynn effect (McGrew, 2010). Some researchers argue that this effect is closely related to the improvement in environmental resources. A possible explanation might be the prevalence of education and its increase in quality provided through formal and informal (Daley et al., 2003; Eppig et al., 2010). Consequently, over and above improving school curricula, the rapid spread of computer games or television may also lead to cognitive development.

In other words, today, technological tools can familiarize us with more complex thinking and make it easier to understand these complex thoughts. This socio-cultural shift could be the catalyst for the Flynn effect. The practical effect might be another explanation. Accordingly, today's children encounter tests similar to intelligence tests more frequently. So, they both learn about the different kinds of questions and get better at answering these kinds of cognitive questions.

According to this theory, it may be implied that new generations are not smarter than old generations; the intelligence tests may be updated. However, much more research is needed before such a generalization can be made. In particular, trend analysis for intelligence in different years will present a broader picture for this debate.

Besides the Flynn Effect, a considerable number of studies refer to the decline of IQ scores in the population over time (e.g., Dutton & Lynn, 2015; Pietschnig & Voracek, 2015; Shayer & Ginsburg, 2009; Shayer et al., 2007). This phenomenon is called the Negative Flynn Effect (Dutton et al., 2016) or the anti-Flynn Effect (Woodley & Meisenberg, 2013). Since the mid-1990s, there has been a decrease in IQ scores in Norway, Denmark, Australia, Britain, the Netherlands, Sweden, and Finland (Dutton et al., 2016).

Different factors have caused the decline in the global intelligence score. Bratsberg and Rogeberg (2018) made a general grouping as genetic and environmental. On the other hand, Woodley and Meisenberg (2013) examined the theories about the causes of the anti-Flynn Effect in four basic categories:

- Declining cultural and environmental quality,
- Statistical explanations, such as selecting an inappropriate sample,
- Biological explanations based on the idea of dysgenic,
- Hybrid effect, which is the idea that dysgenics and environmental quality are evaluated together.

In summary, experts state that the IQ changes (gains or losses), known as the Flynn Effect and the anti-Flynn Effect, can be explained by both environmental factors

such as better health, better school education, better nutrition, and better educated parents and genetic factors such as dysgenic (Rindermann et al., 2017; Woodley & Dunkel, 2015). In recent years, COVID-19 may be the most crucial global change that affects environmental factors (Haleem et al., 2020; Rume & Islam, 2020).

The COVID-19 pandemic and the measures have had a significant effect on the education of children in Turkey as well as worldwide. As of March 11, 2020, in the field of public life, various measures have been taken with the declaration of the COVID-19 disease as an epidemic. Due to the rapid spread of the disease, the Ministry of National Education (MoNE) activated the distance education system in order to support students academically and socially. Distance education, which started on March 23, 2020, lasted until April 30, 2021. While this raises concerns about the education of children, researchers have begun to investigate the effects of the pandemic in the context of different variables. Research on COVID-19, both around the world (Azevedo et al., 2021; Engzell et al., 2021; Kuhfeld et al., 2020) and in Turkey (Bayburtlu, 2020; Erol & Erol, 2020), reveals that lockdown has negatively affected children's achievement.

On the other hand, according to König and Frey's (2022) meta-analysis study, the closure of schools affected younger students' achievement more negatively than older students. Lockdown not only negatively affected children's cognitive development but also their social and emotional development (Coller & Webber, 2020; Hornstra et al., 2021; Smith et al., 2021; Thorell et al., 2020; Zaccoletti et al., 2020). The study by Başaran et al. (2020) investigates the emotional impact of the lockdown. In this study, parents reported that during online education, their children had very limited communication with their friends and students' communication with their teachers was only through online platforms. The key result of that study is that children feel unhappy during online education. These findings are in line with results by Hornstra et al. (2021), which indicate that children were much more motivated before the lockdown. All in all, COVID-19 has negatively affected students' achievement and motivation. This negative impact on achievement may be associated with the impact of environmental variables, which is considered the most dominant cause of the anti-Flynn Effect.

Apart from the sources of the Flynn Effect and the anti-Flynn Effect, these effects have been studied widely across gender differences. Research results differ depending on population limitations or sample size. Some of these studies indicate the same Flynn Effect or very little difference between boys and girls (Bordone et al., 2015; Pietschnig et al., 2011). In studies with larger samples, it was determined that the Flynn Effect was stronger in girls than in boys (Must et al., 2003a; Rönnlund & Nilsson, 2009; Weber et al., 2017). In the anti-Flynn Effect, it is said that the number of boys is going down faster in terms of IQ scores than the number of girls (Shayer et al., 2007).

### **Current Study**

This research differs from the aforementioned studies in four dimensions. Firstly, this study investigates the trend of students' intelligence in the last six years (2016–2021) when the COVID-19 pandemic was also experienced. Second, we conducted this study with primary school students. Although the Flynn effect has been extensively studied in adolescents and adult populations (Pietschnig et al., 2021), its effect on primary school students is not well known. Third, the Flynn effect was

investigated with different intelligence tests and developmental tests, but no research has yet been done on the ASIS intelligence scale. Finally, the literature on Flynn Effect studies is very limited in economically developing countries (Rodgers, 1999), such as Turkey. Kagıtcıbası and Biricik (2011) presented IQ gains for Turkey in the Goodenough-a-Man Draw test with 258 fifth graders. Based on their results, the average IQ gain from 1977 to 2010 (33 years) in the three different population groups was 5.24 IQ (1.59 IQ points in ten years). Uluç et al. (2014) compared the Turkish norms' composite scores of WISC-R in 1984 with the Turkish norms' composite scores of WISC-IV in 2012. The participants of the study included eighty-seven children and adolescents. Researchers found that the scores of WISC-R were significantly higher than the scores of WISC-IV, and the difference could be corrected with the Flynn Effect. In this study, the number of participants was larger than in the previous research, and we used ASIS, which was the first developed intelligence test based on Turkish culture. In this respect, the current study will add a different perspective to Flynn Effect research.

In this study, a trend analysis was conducted to determine the trend of students' general intelligence, verbal intelligence, and visual intelligence scores in the last six years (2016-2021). In accordance with this purpose, the following questions given below were researched.

1. What is the trend of the students' general intelligence, verbal intelligence, and nonverbal intelligence scores?
2. What is the trend of the female students' general intelligence, verbal intelligence, and nonverbal intelligence scores?
3. What is the trend of the male students' general intelligence, verbal intelligence, and nonverbal intelligence scores?

## Method

### Participants

The characteristics of the participants are presented in Table 1.

Table 1  
*The Characteristics of Participants*

Year	Gender		Total
	Male	Female	
2016	120	107	227
2017	117	111	228
2018	96	122	218
2019	224	220	444
2020	146	147	293
2021	381	401	782
Total	1084	1108	2192

The sample for this study was selected by purposeful sampling. Participants included 2192 students who were in first grade at a primary school in the city of Eskisehir. These students were attending three different schools. Of the total sample, 1084 were male, and 1108 were female. The measures of the central tendency of students' ages in each year were similar. The ages of the participants varied between 5.5 and 7 years old. The mean of the students' ages was found to be 6.28. In 2018, the median and mode value were both 6-years-old.

### **Instrument**

The Anadolu-Sak Intelligence Scale was used to assess participants' intelligence (ASIS). The ASIS is the first intelligence test created, standardized, and normed in Turkey (Sak et al., 2016). Children aged 4 to 12 are given the test individually. It offers an overall intelligence assessment, a nonverbal IQ index, and a verbal IQ index (GIQ). The seven ASIS subtests yield the GIQ, the three verbal subtests yield the VIQ, and the four nonverbal subtests yield the NIQ. Vocabulary, verbal analogical reasoning, and verbal short-term memory make up the verbal subtests. Visual analogical reasoning, perceptual reasoning, visual ordered memory, and visual memory for patterns are all nonverbal subtests. ASIS is a reliable and effective intelligence tool. Several research has shown its validity and reliability for technical qualities (see, Cırık et al., 2020; Sözel et al., 2018; Tamul et al., 2020). General IQ, Verbal IQ, and Visual IQ each had reliability values of 0.99, 0.99, and 0.97, respectively (Sak et al., 2016). According to research on the ASIS's criteria validity, its scores substantially correspond with academic performance, with correlations ranging from .57 to .83 (Sak et al., 2019). In different research, the coefficients used to compare the ASIS, UNIT, and RIAS scores varied from .50 to .82 (Dülger, 2018).

### **Data Collection and Data Analysis**

Data was gathered between 2016 and 2021. Each year, in September and October, first-graders were given the ASIS. Between 2016 and 2018, data was gathered in one school; in 2019, three schools; in 2020, two schools; and in 2021, three schools. Each elementary school is located in the heart of the city and is in a comparable socioeconomic group. In order to administer ASIS to pupils at a primary school, a protocol was signed between the research institution and the MoNE in 2016. ASIS was not given in any schools in 2020 as a result of the COVID-19 pandemic. As a result, fewer people participated this year than in previous years. Twenty-one examiners who are authorized to use ASIS delivered it in line with their prescribed administration methods. Each student participant took the test in a school room that had been set up for testing. Every room was suitable for individual testing. ASIS administration took around between 25 and 45 minutes.

In order to examine the IQ trend curve of the students, the General Intelligence Index (GIQ), the Verbal Intelligence Index (VIQ), and the Nonverbal Intelligence Index (NIQ) scores of ASIS were used. Considering these three indexes, the mean of scores in different years was compared by trend analysis (Çetiner, 2000).



## Findings

### The Trend of the Students' General, Verbal and Visual Intelligence Scores

Descriptive findings related to the students' ASIS scores between the years 2016 and 2021 are presented in Table 2. The mean general intelligence (GIQ) scores ranged from 97.67 (in the year 2021) to 103.67 (in the year 2016). The mean verbal intelligence (VIQ) scores ranged from 99.20 (in the year 2021) to 103.64 (in the year 2017). The nonverbal intelligence (NIQ) scores ranged from 97.19 (in the year 2021) to 103.91 (in the year 2016). The standard deviation values for GIQ, VIQ, and NIQ ranged from 12.481 to 16.028.

Table 2

#### *Descriptive Statistics of The Intelligence Indexes*

Year	Intelligence Indexes	N	Min.	Max.	Mean	SD	Skewness	Kurtosis
2016	GIQ	227	46	135	103.67	14.351	-.605	1.187
	VIQ	227	42	141	102.99	16.028	-.469	.832
	NIQ	227	55	136	103.91	13.693	-.252	.473
2017	GIQ	228	52	144	102.63	14.610	-.295	1.311
	VIQ	228	57	146	103.64	13.622	-.163	.771
	NIQ	228	54	154	101.30	15.699	-.109	.818
2018	GIQ	218	69	151	101.34	12.481	.145	.730
	VIQ	218	31	141	101.35	14.038	-.553	2.795
	NIQ	218	38	151	100.84	13.457	-.329	2.237
2019	GIQ	444	46	142	101.66	14.768	-.217	.428
	VIQ	444	58	137	101.80	14.478	-.232	.102
	NIQ	444	48	146	101.48	15.249	-.199	.338
2020	GIQ	293	56	135	100.33	12.426	-.258	.533
	VIQ	293	50	130	100.30	11.754	-.369	.857
	NIQ	293	56	137	100.54	14.523	-.015	-.116
2021	GIQ	782	11	153	97.67	15.024	-.199	1.638
	VIQ	782	9	137	99.20	14.419	-.626	2.184
	NIQ	782	29	156	97.19	15.639	.091	.857

We found mean differences in GIQ, VIQ, and NIQ scores over the years (see Table 3). However, in our study, we did not conduct any variance analysis or slope analysis to examine whether these mean differences were significant or not. Because our data was acquired from standardized scores, not raw scores. Therefore, the data was not appropriate for these analyses. We examined only descriptive analysis to reveal the trend of the students' intelligence scores in our study (Çetiner, 2000).

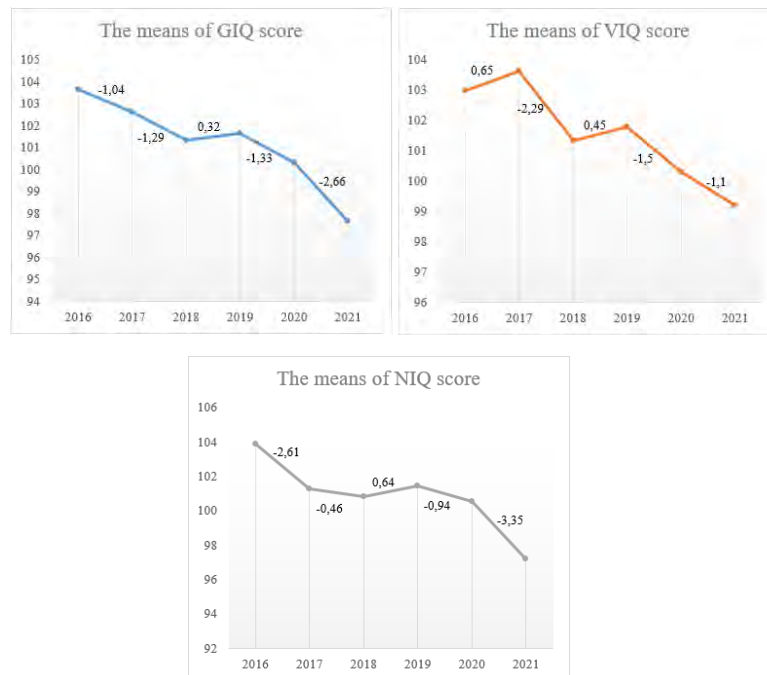
Table 3

*The Means of the Intelligence Indexes*

Intelligence Indexes	Years					
	2016	2017	2018	2019	2020	2021
GIQ	103.67	102.63	101.34	101.66	100.33	97.67
VIQ	102.99	103.64	101.35	101.80	100.30	99.20
NIQ	103.91	101.30	100.84	101.48	100.54	97.19

Figure 1 shows the trend line. In the three graphs of Figure 1, the numbers on the line represent the mean difference between the years.

Figure 1

*The Means of the Intelligence Indexes*

Trend analysis showed that there was a downward tendency from 2016 to 2021 regarding GIQ, VIQ, and NIQ scores. Especially in 2021, there was a notable decrease in these three index scores compared to scores in other years. Considering the GIQ and NIQ scores, the highest scores of students were in 2016, while the lowest scores were in 2021. On the other hand, VIQ scores were examined. The highest scores were in 2017, whereas the lowest scores were in 2021. Figure 1 shows that almost all GIQ, VIQ, and NIQ scores have decreased over the years.



### The Trend of Girls' and Boys' General, Verbal and Visual Intelligence Scores

Girls' and boys' GIQ, VIQ, and NIQ mean scores were presented in Table 4. In Figure 2, we examine the mean intelligence scores of girls and boys in the last six years (2016–2021).

Table 4

*The Means of the Girls' and Boys' Intelligence Indexes*

	Intelligence Indexes	Years					
		2016	2017	2018	2019	2020	2021
Girls	GIQ	104.20	102.46	101.70	101.57	101.37	97.32
	VIQ	105.28	103.67	102.37	101.80	101.69	99.01
	NIQ	102.61	100.93	101.03	101.26	101.14	96.84
Boys	GIQ	103.19	102.79	100.88	101.75	99.29	98.04
	VIQ	100.94	103.61	100.06	101.79	98.90	99.41
	NIQ	105.07	101.65	100.60	101.69	99.95	97.56

Figure 2

*The Means of the Girls' and Boys' Intelligence Indexes*



As seen in Figure 2, we found a decrease in girls' GIQ and VIQ scores between 2016 and 2021. There were decreases in girls' NIQ scores from 2016 to 2017 and from 2019 to 2021, whereas there was an increase in girls' NIQ scores between 2017 and 2019. The girls' highest scores in all intelligent indexes (GIQ, VIQ, and NIQ) were in 2016, whereas the girls' lowest scores in all intelligent indexes (GIQ, VIQ, and NIQ) were in 2021. Furthermore, the most decrease in girls' scores in 2021. Examining the means intelligence scores of girls, we may reveal that there was a downward tendency from 2016 to 2021.

We found ups and downs in the scores for boys' GIQ, VIQ, and NIQ between 2016 and 2021 (see Figure 3). There was an increase in boys' GIQ and NIQ scores from 2018 to 2019, but there were decreases in boys' GIQ and NIQ scores from 2016 to 2018 and 2019 to 2021. Second, there was an increase in boys' VIQ scores from 2016 to 2017, from 2018 to 2019, and from 2020 to 2021, but there were decreases in boys' VIQ scores from 2017 to 2018 and from 2019 to 2020. On the other hand, the boys' highest scores of GIQ and NIQ were in 2016, whereas the highest score of VIQ was in 2017. The boys' lowest scores of all GIQ and NIQ were in 2021, whereas the lowest score of VIQ was in 2020. As a result, the outcomes varied over time when taking into account the boys' IQ scores.

### Discussion and Conclusion

Although the Flynn Effect has been widely accepted, research has drawn attention to the anti-Flynn effect in recent years. In the current study, we investigate the changes in general intelligence scores, verbal intelligence index scores, and nonverbal intelligence index scores of first-year students over a six-year period (2016 to 2021). We also investigate the changes in GIQ, VIQ, and NIQ scores in terms of gender.

The findings of the current study both support and differ from previous Flynn Effect research. According to the research findings, there was a downward tendency in GIQ, VIQ, and NIQ scores between 2016 and 2021. This finding is in line with many research findings (e.g., Dutton & Lynn, 2015; Pietschnig et al., 2021; Shayer & Ginsburg, 2009; Teasdale & Owen, 2005). The results show that IQ score decreases differ according to indices (GIQ- VIQ- NIQ). Generally, the decline rates show that the highest decline is in NIQ scores. Nonverbal intelligence scores from ASIS indexes are associated with fluid intelligence (Sak et al., 2016). Therefore, it can be assumed that this decrease in NIQ scores is due to the change in fluent intelligence. This result is consistent with the empirical observations that Flynn Effect has the strongest effect on fluid intelligence compared to crystallized intelligence (Flynn, 2000; Pietschnig & Voracek, 2015; Woodley & Meisenberg, 2013). Our results indicate that the highest decrease occurred between 2020 and 2021, with losses of -2.66 GIQ points on the total scale, -1.1 VIQ points, and -3.35 NIQ points. As Woodley and Dunkel (2015) stated, the decrease in IQ scores can be explained by the aspect of intelligence that is affected by environmental variables. It is inevitable that the most dramatic environmental factor after 2019 is the COVID-19 pandemic. Therefore, the decline in IQ scores between the years 2020 to 2021 is most likely rooted in Covid 19 epidemic. Previous research highlights the consequences of lockdown on stress, anxiety, boredom, fear, depression, and other psychological problems (Brooks et al., 2020). Because of the lockdown,

psychological problems have been observed in 40.4% of young people (Liang et al., 2020). The COVID-19 pandemic has affected both the social-emotional development and cognitive development of children. In this process, with the effect of the lockdown, the students stayed away from their daily routines, such as the school environment. Students could not go out for a long time and could not communicate with their friends and teachers. Studies show that lockdown has reduced students' motivation to learn (Hornstra et al., 2021) and well-being (Grechyna, 2020; Thorell et al., 2020), and as a result, decreases in their emotional and cognitive skills have been determined (Coller & Webber, 2020; Martin-Requejo & Santiago-Ramajo, 2021). Research by Kara (2020) with 2590 students during the Covid-19 process shows that students generally have negative feelings (sad, restless, angry, worried and fearful) about Covid-19. Studies examining the effect of motivation on cognitive performance (e.g., Donovan, 2015; Duckworth et al., 2011) and studies showing that (state, trait, and test) anxiety negatively affects performance on IQ measures (e.g., Gass & Curiel, 2011; Hopko et al., 2005; Wetherell et al., 2002) support this conclusion.

Bratsberg and Rogeberg (2018) hypothesized that the Flynn Effect and the anti-Flynn effect are both environmentally caused. According to Bratsberg and Rogeberg, the causes for positive and anti-Flynn effects are migration, educational values, education and school systems, education in families, nutrition, and health. Within the framework of all these reasons, the findings of the study can be discussed. It can be stated that the sudden change in the school system and the start of distance education during the COVID period may be the prominent reason for the findings. Distance education is one of the specific types of education that requires expertise. Teachers who had very limited or no experience in distance education during the Covid period were included in the system very quickly and it was tried to maintain the education. This situation may have forced teachers. The difficulties experienced by the teachers may have been reflected in the performance of the students as a lack of education. Research by Önder (2022) shows that teachers encountered many problems and think that learning losses occurred during the Covid-19 process. In addition, this research indicates that the reason for the difficulties experienced by the teachers may be their low techno-pedagogical education proficiency. Similar results have been reported in many studies. (e.g., Avcı & Yıldız, 2021; Hanbay-Tiryaki & Balaman, 2021; Can, 2020; Kuloğlu & Akpınar, 2022; Külekçi-Akyavuz & Çakın, 2020; Türker & Dündar, 2020). Therefore, the sudden change in the school system during the Covid process may be the reason for the decrease in IQ scores. In addition to the educational activities provided by the teachers, the education in the family is an important variable that affects the performance of the children. The study conducted with 2089 children and families by Lugo-Gil and Tamis-LeMonda (2008) indicates that parenting quality and family resources (e.g., money and time) contributed to children's cognitive performance. We can state that the inadequacy of the family education support provided by the families to their children during the Covid process will be another reason for the decrease in the IQ scores in the research.

In our study, the anti-Flynn Effect was found in both girls and boys. Our study revealed that the anti-Flynn Effect is stronger in girls than in boys. Above all, girls' GIQ, VIQ, and NIQ scores 2021 showed a sharp decline compared to boys. Many Flynn

Effect studies show that girls have a higher change in IQ scores. (Must et al., 2003a; Rönnlund & Nilsson, 2009; Weber et al., 2017). The psychological effect of the pandemic can explain the greater decrease in the IQ scores of female students. Pandemic precautions such as social distancing and many others have caused psychological conditions such as fear and anxiety to occur, and students are affected psychologically (Cao et al., 2020; Wang et al., 2020). The difficulties experienced during Covid-19 negatively affected the social, emotional, and psychological well-being of the students. According to Karaman et al. (2021), variables such as anxiety, depression, negative self-perception, and the impact of traumatic events had different effects on male and female students. Female students have higher scores in all these variables than male students. In other words, female students experienced the Covid-19 process more severely than male students (Czymara et al., 2021; Karaman et al., 2021). This effect may have caused the decrease in the cognitive performance of female students to be more severe. Moreover, prior studies highlighting the negative effect of anxiety on IQ test performance support this view (e.g., Hopko et al., 2005). There are also studies that do not confirm our findings on gender differences. The finding is not in line with the results by Shayer et al. (2007). Shayer et al. used the Volume & Heaviness (VH) test based on Piaget's cognitive development model in their study. The VH test differs from intelligence tests based on the Cattell-Horn-Carroll model of intelligence. Many of the test items in VH require neither fluid intelligence nor crystallized intelligence, but it can be argued that they contain the necessary conditions for success in tests of crystallized intelligence involving quantitative reasoning (Shayer et al., 2007). In this study, the ASIS test based on the Cattell-Horn-Carroll model of intelligence was used. The use of psychometric measurement tools based on different theoretical models in studies may have led to different results in terms of gender. On the other hand, Weber et al. (2017) determined that gender differences in the Flynn Effect varied across the regions. According to this study, the Flynn Effect gender interaction differs in Northern, Central, and Southern Europe. It should be noted that an Estonian (Must et al., 2003b), an English (Shayer et al., 2007), and a Swedish (Rönnlund & Nilsson, 2009) study also have reported different result in terms of gender. Our study was conducted with Turkish students. Therefore, this may be another reason girls' scores decreased more than boys in our study.

In conclusion, we found that the GIQ, VIQ, and NIQ scores decrease over time. Our findings reveal that there is a sharp decrease between 2020 and 2021. The decrease may have occurred due to the negative impact of COVID-19 on the psychological structure of the students. Therefore, this situation will also be reflected in students' cognitive performance. Another result of this study is that girls are more likely to be under the influence of decline than boys. Considering all this together, it can be said that our research findings support the anti-Flynn Effect, but further research is needed to confirm this phenomenon.

### **Limitations and Suggestions**

There are a number of limitations to this study. One of these limitations is that the participants in our samples came from three different schools. The main reason the sample was limited to three schools is that the Ministry of National Education approved the ASIS protocol for these three schools. Further studies can be conducted to include

schools in regions with different demographic characteristics, such as different socio-economic statuses and different cultural backgrounds. On the other hand, this study was conducted with students between the ages of 5.5 and 7. The later studies also included older students. The Flynn Effect differed across countries and was more prominent in adults than children (Laciga & Cigler, 2017). IQ gains may differ between younger to older children (Flynn, 1984b, 2009; Lynn, 2009). One of the latest research by Flynn and Shayer (2018) shows no change in preschoolers, mild losses at high school, and possible gains by adults in the Netherlands data. On the other hand, in this research Australia and France data shows a different result. Also, the researchers conclude that IQ trends vary dramatically by age. So, in future studies, GIQ changes in older children can be looked at, and the results and reasons can be discussed.

A second limitation is that we did not test the measurement invariance of ASIS. Measurement invariance is testing whether the measurement results are equal to each other. Ensuring the measurement invariance of a scale is vital in terms of using the measured variable in different groups. Before making a comparison, a researcher should first determine whether the measuring instrument is operating in a similar manner for all groups (Huck, 2012). It may be recommended to examine the Flynn Effect after testing measurement invariance analyses in different groups (e.g., gender, different cultures, and different socio-economic groups).

Finally, it needs to be acknowledged that in this study, we used one intelligence test, ASIS. Results may vary in studies conducted with different intelligence tests. Therefore, the results of different intelligence tests can be examined in future studies.

### **Statement of Responsibility**

Bilge Bal-Sezerel; determining the study subject, data collection and analysis, writing method and findings sections and reviewing. N. Nazlı Ateşgöz; determining the study subject, data collection and analysis, writing abstract, introduction, limitations and suggestion sections and reviewing. Nilgün Kirişçi, data collection, writing introduction, discussion and conclusion, limitations and suggestion sections and reviewing.

### **Conflicts of Interest**

The authors declared that there was no conflict of interest.

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### References

- Avcı, İ., & Yıldız, E. (2021). Covid-19 Pandemi sürecinde uzaktan eğitimi kullanan öğrencilerin memnuniyet ve davranışlarının teknoloji kabul modeli çerçevesinde incelenmesi [Investigation of satisfaction and behaviors of students using distance education in the covid-19 pandemic process within the framework of technology acceptance model]. *Gümüşhane Üniversitesi Sosyal Bilimler Enstitüsü Elektronik Dergisi*, 12(3), 814-830.
- Azevedo, J. P., Hasan, A., Goldemberg, D., Geven, K., & Iqbal, S. A. (2021). Simulating the potential impacts of COVID-19 school closures on schooling and learning outcomes: A set of global estimates. *The World Bank Research Observer*, 36(1), 1-40. <https://doi.org/10.1093/wbro/lkab003>
- Balaman, F., & Hanbay Tiryaki, S. (2021). Corona Virüs (Covid-19) nedeniyle mecburi yürütülen uzaktan eğitim hakkında öğretmen görüşleri [The Opinions of teachers about compulsory distance education due to corona virus (Covid-19)]. *İnsan ve Toplum Bilimleri Araştırmaları Dergisi*, 10(1), 52-84.
- Başaran, M., Doğan, E., Karaoğlu, E., & Şahin, E. (2020). Koronavirüs (covid-19) pandemi sürecinin getirisi olan uzaktan eğitimin etkililiği üzerine bir çalışma [A study on effectiveness of distance education, as a return of coronavirus (covid-19) pandemic process]. *Academia Eğitim Araştırmaları Dergisi*, 5(2), 368-397.
- Bayburtlu, Y. S. (2020). Covid-19 pandemi dönemi uzaktan eğitim sürecinde öğretmen görüşlerine göre Türkçe eğitimi [Turkish education during covid-19 pandemic distance education process]. *Turkish Studies*, 15(4), 131-151.
- Binet, A., & Simon, T. (1905). Méthodes nouvelles pour le diagnostic du niveau intellectuel des anormaux [New methods for the diagnosis of intellectual level of subnormals]. *L'Année Psychologique*, 11, 191-244.
- Bordone, V., Scherbov, S., & Steiber, N. (2015). Smarter every day: The deceleration of population ageing in terms of cognition. *Intelligence*, 52, 90-96. <https://doi.org/10.1016/j.intell.2015.07.005>
- Boring, E. G. (1961). Intelligence as the Tests Test It. In J. J. Jenkins & D. G. Paterson (Eds.), *Studies in individual differences: The search for intelligence* (pp. 210-214). Appleton-Century-Crofts. <https://doi.org/10.1037/11491-017>
- Bratsberg, B., & Rogeberg, O. (2018). Flynn effect and its reversal are both environmentally caused. *Proceedings of the National Academy of Sciences*, 115(26), 6674-6678. <https://doi.org/10.1073/pnas.1718793115>
- Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., & Rubin, G. J. (2020). The psychological impact of quarantine and how to reduce



- it: rapid review of the evidence. *The Lancet*, 395(10227), pp. 912–920. [https://doi.org/10.1016/S0140-6736\(20\)30460-8](https://doi.org/10.1016/S0140-6736(20)30460-8)
- Can, E. (2020). Coronavirüs (Covid-19) pandemisi ve pedagojik yansımaları: Türkiye’de açık ve uzaktan eğitim uygulamaları [Coronavirus (Covid-19) pandemic and its pedagogical reflections: Open and distance education practices in Turkey]. *AUAD*, 6(2), 11-53.
- Cao, W., Fang, Z., Hou G., Han M., Xu X., Dong J., & Zheng, J. (2020). The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Res.* 287, 112934. <https://doi.org/10.1016/j.psychres.2020.112934>
- Cırık, M., Sak, U., & Öpengin, E. (2020). Dikkat eksikliği hiperaktivite bozukluğu olan çocukların Anadolu-Sak Zekâ Ölçeği profillerinin incelenmesi [An investigation of cognitive profiles of children with attention deficit hyperactivity disorder through Anadolu-Sak Intelligence Scale]. *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Özel Eğitim Dergisi*, 21(4), 663-685. <https://doi.org/10.21565/ozelegitimdergisi.570505>
- Coller, R. J., & Webber, S. (2020). COVID-19 and the well-being of children and families. *Pediatrics*, 146(4), 1-3. <https://doi.org/10.1542/peds.2020-022079>
- Czymara, C. S., Langenkamp, A., & Cano, T. (2021). Cause for concerns: gender inequality in experiencing the COVID-19 lockdown in Germany. *European Societies*, 23(sup1), 68-81. <https://doi.org/10.1080/14616696.2020.1808692>
- Çetiner, E. (2000). *İşletmelerde mali analiz [Business financial analysis]*. Gazi Kitabevi.
- Daley, T. C., Whaley, S. E., Sigman, M. D., Espinosa, M. P., & Neumann, C. (2003). IQ on the rise: The Flynn effect in rural Kenyan children. *Psychological Science*, 14, 215–219. <https://doi.org/10.1111/1467-9280.02434>
- Donovan, N. (2015). The effects of intrinsic and extrinsic motivation on cognitive performance in humans. *The Huron University College Journal of Learning and Motivation*, 53(1), 84–96.
- Duckworth, A. L., Quinn, P. D., Lynam, D. R., Loeber, R., & Stouthamer-Loeber, M. (2011). Role of test motivation in intelligence testing. *Proceedings of the National Academy of Sciences*, 108(19), 7716–7720. <https://doi.org/10.1073/pnas.1018601108>
- Dülger, E. (2018). *Anadolu-Sak Zekâ Ölçeği'nin (ASIS) ölçüt geçerliği çalışması [A study on the criterion validity of the Anadolu-Sak Intelligence Scale (ASIS)]* (Dissertation Number: 494226). [Unpublished master thesis, Anadolu University]. Yükseköğretim Kurulu Ulusal Tez Merkezi.
- Dutton, E., & Lynn, R. (2015). A negative Flynn Effect in France, 1999 to 2008–9. *Intelligence*, 51(2015), 67–70. <https://doi.org/10.1016/j.intell.2015.05.005>
- Dutton, E., van der Linden, D., & Lynn, R. (2016). The negative Flynn Effect: A systematic literature review. *Intelligence*, 59, 163-169. <https://doi.org/10.1016/j.intell.2016.10.002>

- Engzell, P., Frey, A., & Verhagen, M. D. (2021). Learning loss due to school closures during the COVID-19 pandemic. *Proceedings of the National Academy of Sciences*, *118*(17), 1-7. <https://doi.org/10.1073/pnas.2022376118>
- Eppig, C., Fincher, C. L., & Thornhill, R. (2010). Parasite prevalence and the worldwide distribution of cognitive ability. *Proceedings of the Royal Society: Series B. Biological Sciences*, *277*, 3801-3808. <https://doi.org/10.1098/rspb.2010.0973>
- Erol, M., & Erol, A. (2020). Koronavirüs pandemisi sürecinde ebeveynleri gözünden ilkökul öğrencileri [Primary school students through the eyes of their parents during covid-19 pandemic]. *Milli Eğitim Dergisi*, *49*(1), 529-551. <https://doi.org/10.37669/milliegitim.766194>
- Flynn, J. R. (1987). Massive IQ gains in 14 nations: What IQ tests really measure. *Psychological Bulletin*, *101*, 171-191. <https://psycnet.apa.org/doi/10.1037/h0090408>
- Flynn, J. R. (2012). The big IQ question. *New Scientist*, *215*(2881), 26-27.
- Flynn, J. R. (1984a). The mean IQ of Americans: Massive gains 1932 to 1978. *Psychological Bulletin*, *95*, 29-51. <https://doi.org/10.1037/0033-2909.95.1.29>
- Flynn, J. R. (1984b). IQ gains and the Binet decrements. *Journal of Educational Measurement*, *21*(3), 283-290.
- Flynn, J. R. (2000). IQ gains and fluid g. *American Psychologist*, *55*(5), 543. <https://doi.org/10.1037/0003-066X.55.5.543>
- Flynn, J. R. (2009). Requiem for nutrition as the cause of IQ gains: Raven's gains in Britain 1938-2008. *Economics & Human Biology*, *7*(1), 18-27. <https://doi.org/10.1016/j.ehb.2009.01.009>
- Gass, C. S., & Curiel, R. E. (2011). Test anxiety in relation to measures of cognitive and intellectual functioning. *Archives of Clinical Neuropsychology*, *26*(5), 396-404. <https://doi.org/10.1093/arclin/acr034>
- Gottfredson, L. S. (1997). Mainstream science on intelligence: An editorial with 52 signatories, history, and bibliography. *Intelligence*, *24*(1), 13-23.
- Grechyna, D. (2020). Health threats associated with children lockdown in Spain during COVID-19. *SSRN Electronic Journal*, pp. 1-12. <https://doi.org/10.2139/ssrn.3567670>
- Haleem, A., Javaid, M., & Vaishya, R. (2020). Effects of COVID-19 pandemic in daily life. *Current Medicine Research and Practice*, *10*(2), 78-79. <https://doi:10.1016/j.cmrp.2020.03.011>
- Hiscock, M. (2007). The Flynn effect and its relevance to neuropsychology. *Journal of Clinical and Experimental Neuropsychology*, *29*(5), 514-529. <https://doi.org/10.1080/13803390600813841>
- Hopko, D. R., Crittendon, J. A., Grant, E., & Wilson, S. A. (2005). The impact of anxiety on performance IQ. *Anxiety, Stress & Coping*, *18*(1), 17-35. <https://doi.org/10.1080/10615800412336436>
- Hornstra, L., van den Bergh, L., Denissen, J. J. A., Diepstaten, I., & Bakx, A. (2021). Parents' perceptions of secondary school students' motivation and well-being

- before and during the COVID-19 lockdown: The moderating role of student characteristics. *Journal of Research in Special Educational Needs*, 22(3), 209-220. <https://doi.org/10.1111/1471-3802.12551>
- Huck, S. W. (2012). *Reading statistics and research* (6th ed.). Pearson.
- Kagıtcıbası, C., & Biricik, D. (2011). Generational gains on the Draw-a-Person IQ scores: A three-decade comparison from Turkey. *Intelligence*, 39(5), 351-356. <https://doi.org/10.1016/j.intell.2011.06.001>
- Kara, Y. (2020). Pandemi sürecindeki öğrenci deneyimleri: Bakırköy ilçesi örneği [Students' experiences in the pandemic duration: the case of Bakırköy district]. *Avrasya Sosyal ve Ekonomi Araştırmaları Dergisi*, 7(7), 165-176.
- Karaman, M. A., Eşici, H., Tomar, İ. H., & Aliyev, R. (2021). COVID-19: Are school counseling services ready? Students' psychological symptoms, school counselors' views, and solutions. *Frontiers in Psychology*, 12, 647-740. <https://doi.org/10.3389/fpsyg.2021.647740>
- König, C., & Frey, A. (2022). The impact of COVID-19-related school closures on student achievement-A meta-analysis. *Educational Measurement: Issues and Practice*, 41(1), 16-22. <https://doi.org/10.1111/emip.12495>
- Kuhfeld, M., Soland, J., Tarasawa, B., Johnson, A., Ruzek, E., & Liu, J. (2020). Projecting the potential impact of COVID-19 school closures on academic achievement. *Educational Researcher*, 49(8), 549-565. <https://doi.org/10.3102/0013189X20965918>
- Külekeçi-Akyavuz, E., & Çakın, M. (2020). Covid-19 salgınının eğitime etkisi konusunda okul yöneticilerinin görüşleri [School administrators' views on the effect of covid-19 pandemic on education]. *Turkish Studies*, 15(4), 723-737. <https://dx.doi.org/10.7827/TurkishStudies.44140>
- Kuloğlu, A., & Akpınar, B. (2022). Covid-19 pandemi sürecindeki çevrimiçi eğitimin öğretmen perspektifinden değerlendirilmesi. *Fırat Üniversitesi Sosyal Bilimler Dergisi*, 32(3), 921-932.
- Laciga, J., & Cigler, H. (2017). The Flynn effect in the Czech Republic. *Intelligence*, 61, 7-10. <https://doi.org/10.1016/j.intell.2016.11.005>
- Liang, L., Ren, H., Cao, R., Hu, Y., Qin, Z., Li, C., & Mei, S. (2020). The effect of COVID-19 on youth mental health. *Psychiatric Quarterly*, 91, 841-852. <https://doi.org/10.1007/s11126-020-09744-3>
- Lindquist, E. F., & Hieronymus, A. N. (1955). *Iowa tests of basic skills*. Houghton Mifflin.
- Lugo-Gil, J., & Tamis-LeMonda, C. S. (2008). Family resources and parenting quality: Links to children's cognitive development across the first 3 years. *Child Development*, 79(4), 1065-1085. <https://doi.org/10.1111/j.1467-8624.2008.01176.x>
- Lynn, R. (2009). What has caused the Flynn effect? Secular increases in the development quotients of infants. *Intelligence*, 37, 16-24. <https://doi.org/10.1016/j.intell.2008.07.008>

- Martin-Requejo, K., & Santiago-Ramajo, S. (2021). Reduced emotional intelligence in children aged 9–10 caused by the covid-19 pandemic lockdown. *Mind, Brain, and Education, 15*(4), 269-272. <https://doi.org/10.1111/mbe.12297>
- McGrew, K. S. (2010). The Flynn effect and its critics: Rusty linchpins and “Lookin’ for g and Gf in some of the wrong places.” *Journal of Psychoeducational Assessment, 28*, 448–468. <https://doi.org/10.1177/0734282910373347>
- Must, O., Must, A., & Raudik, V. (2003a). The Flynn effect for gains in literacy found in Estonia is not a Jensen effect. *Personality and Individual Differences, 34*, 1287–1292. [https://doi.org/10.1016/S0191-8869\(02\)00115-0](https://doi.org/10.1016/S0191-8869(02)00115-0)
- Must, O., Must, A., & Raudik, V. (2003b). The secular rise in IQs: In Estonia, the Flynn effect is not a Jensen effect. *Intelligence, 31*(5), 461–471. [https://doi.org/10.1016/S0160-2896\(03\)00013-8](https://doi.org/10.1016/S0160-2896(03)00013-8)
- Önder, E. (2022). COVID-19 salgınında öğretmenlerin uzak eğitime ilişkin deneyimleri [Teachers’ experiences on distance education during the covid-19 pandemic]. *Milli Eğitim Dergisi, 51*(233), 399-418. <https://doi.org/10.37669/milliegitim.787838>
- Otis, A. S., & Lennon, R. T. (1967). *Otis-Lennon mental ability test*. Harcourt Brace Jovanovich Incorporated.
- Pietschnig, J., Deimann, P., Hirschmann, N., & Kastner-Koller, U. (2021). The Flynn effect in Germanophone preschoolers (1996–2018): Small effects, erratic directions, and questionable interpretations. *Intelligence, 86*, 101544. <https://doi.org/10.1016/j.intell.2021.101544>
- Pietschnig, J., & Voracek, M. (2015). One century of global IQ gains: A formal meta-analysis of the Flynn effect (1909–2013). *Perspectives on Psychological Science, 10*(3), 282-306. <https://doi.org/10.1177/1745691615577701>
- Pietschnig, J., Voracek, M., & Formann, A. K. (2011). Female Flynn effects: No sex differences in generational IQ gains. *Personality and Individual Differences, 50*(5), 759–762. <https://doi.org/10.1016/j.paid.2010.12.019>
- Raven, J. C. (1960). *Guide to standard progressive matrices*. Lewis.
- Rindermann, H., Becker, D., & Coyle, T. R. (2017). Survey of expert opinion on intelligence: The Flynn effect and the future of intelligence. *Personality and Individual Differences, 106*, 242–247. <https://doi.org/10.1016/j.paid.2016.10.061>
- Rodgers, J. L. (1999). A critique of the Flynn effect: massive IQ gains, methodological artifacts, or both? *Intelligence, 26*, 337–356. [https://doi.org/10.1016/S0160-2896\(99\)00004-5](https://doi.org/10.1016/S0160-2896(99)00004-5)
- Rönnlund, M., & Nilsson, L. G. (2009). Flynn effects on sub-factors of episodic and semantic memory: Parallel gains over time and the same set of determining factors. *Neuropsychologia, 47*(11), 2174–2180. <https://doi.org/10.1016/j.neuropsychologia.2008.11.007>
- Rume, T., & Islam, S. D. U. (2020). Environmental effects of COVID-19 pandemic and potential strategies of sustainability. *Heliyon, 6*(9), 1-8. <https://doi.org/10.1016/j.heliyon.2020.e04965>
- Sak, U., Bal-Sezerel, B., Ayas, M. B., Özdemir, N. N., Demirel, S., & Öpengin, E. (2016). *Anadolu Sak Zeka Ölçeği uygulayıcı kitabı* [Anadolu Sak Intelligence Scale users’ manuel]. Alf Kırtasiye Basım.

- Sak, U., Bal-Sezerel, B., Dulger, E., Sozel, K., & Ayas, M. B. (2019). Validity of the Anadolu-Sak Intelligence Scale in the identification of gifted students. *Psychological Test and Assessment Modeling*, 61(3), 263-283.
- Shayer, M., & Ginsburg, D. (2009). Thirty years on—a large anti-Flynn effect(II): 13-and 14-year-olds. Piagetian tests of formal operations norms 1976–2006/7. *British Journal of Educational Psychology*, 79(3), 409–418. <https://doi.org/10.1348/978185408X383123>
- Shayer, M., Ginsburg, D., & Coe, R. (2007). Thirty years on—a large anti-Flynn effect? The Piagetian test Volume & Heaviness norms 1975–2003. *British Journal of Educational Psychology*, 77(1), 25–41. <https://doi.org/10.1348/000709906X96987>
- Smith, J., Guimond, F. A., Bergeron, J., St-Amand, J., Fitzpatrick, C., & Gagnon, M. (2021). Changes in students' achievement motivation in the context of the COVID-19 pandemic: A function of extraversion/introversion? *Education Sciences*, 11(1), 30-38. <https://doi.org/10.3390/educsci11010030>
- Sözel, H. K., Öpengin, E., Sak, U., & Karabacak, F. (2018). The discriminant validity of the Anadolu-Sak Intelligence Scale (ASIS) for gifted and other special education groups. *Turkish Journal of Giftedness and Education*, 8(2), 160-180.
- Stern, W. (1912). *Die psychologischen Methoden der Intelligenzprüfung und deren Anwendung an Schulkindern [The psychological methods of intelligence testing and their applications in students]*. Leipzig, Germany: Barth.
- Tamul, Ö. F., Bal-Sezerel, B., Sak, U., & Karabacak, F. (2020). Anadolu-Sak Zekâ Ölçeği'nin (ASIS) sosyal geçerlik çalışması. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi*, 49, 393-412. <https://doi.org/10.9779/pauefd.575479>
- Teasdale, T. W., & Owen, D. R. (2005). A long-term rise and recent decline in intelligence test performance: *The Flynn effect in reverse*, *Personality and Individual Differences*, 39(4), 837–843. <https://doi.org/10.1016/j.paid.2005.01.029>
- Terman, L. M., & Merrill, M. A. (1960). *Stanford-Binet Intelligence Scale: Manual for the third revision, Form L-M*. Houghton Mifflin.
- Thorell, L., Skoglund, C. B., de la Peña, A. G., Baeyens, D., Fuermaier, A., Groom, M., Mammarella, I., & Christiansen, H. (2020). Psychosocial effects of homeschooling during the COVID-19 pandemic: Differences between seven European countries and between children with and without mental health conditions. *PsyArXiv*, 25. <https://doi.org/10.31234/osf.io/68pfx>
- Türker, A., & Dündar, E. (2020). Covid-19 pandemi sürecinde eğitim bilişim ağı (EBA) üzerinden yürütülen uzaktan eğitimlerle ilgili lise öğretmenlerinin görüşleri [The opinions of high school teachers on distance learning which is carried out through EBA (educational informatics network) during covid-19 pandemic period]. *Milli Eğitim Dergisi*, 49(1), 323-342. <https://doi.org/10.37669/milliegitim.738702>
- Uluç, S., Korkmaz, B., & Şahin, Ö. (2014). Reconsideration of Flynn Effect in a Turkish sample: A comparison between WISC-R and WISC-IV IQ scores. *Türk Psikoloji Dergisi*, 29(73), 60-69.
- Wang, C., Pan R., Wan X., Tan Y., Xu L., Ho, C. S., & Ho, R. C. (2020). Immediate psychological responses and associated factors during the initial stage of the 2019



- Coronavirus Disease (COVID-19) epidemic among the general population in China. *International Journal of Environmental Research and Public Health*, 17, 1–25. <https://doi.org/10.3390/ijerph17051729>
- Weber, D., Dekhtyar, S., & Herlitz, A. (2017). The Flynn effect in Europe—Effects of sex and region. *Intelligence*, 60, 39-45. <https://doi.org/10.1016/j.intell.2016.11.003>
- Wechsler, D. (1949). *WISC manual*. Psychological Corporation.
- Wetherell, J. L., Reynolds, C. A., Gatz, M., & Pedersen, N. L. (2002). Anxiety, cognitive performance, and cognitive decline in normal aging. *Journals of Gerontology*, 57, 246–255. <https://doi.org/10.1093/geronb/57.3.P246>
- Woodley, M. A., & Dunkel, C. (2015). In France, are secular IQ losses biologically caused? A comment on Dutton and Lynn. *Intelligence*, 53, 81–85. <http://dx.doi.org/10.1016/j.intell.2015.08.009>
- Woodley, M., & Meisenberg, G. (2013). In the Netherlands the anti-Flynn effect is a Jensen effect. *Personality and Individual Differences*, 54, 871–876. <https://doi.org/10.1016/j.paid.2012.12.022>
- Zaccoletti, S., Camacho, A., Correia, N., Aguiar, C., Mason, L., Alves, R. A., & Daniel, J. R. (2020). Parents' perceptions of student academic motivation during the COVID-19 lockdown: A cross-country comparison. *Frontiers in Psychology*, 11, 1-13. <https://doi.org/10.3389/fpsyg.2020.592670>



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