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Research Article

Investigation of the relationship between Androgen Receptor Gene CAG Repeat Polymorphisms and Turkish gifted students' science attitudes[1]

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Abstract

This study aims to examine the AR gene CAG polymorphisms of gifted students, and to determine whether there is a relationship between this gene region and students' attitudes towards science. The research was conducted with randomly selected gifted students (N = 100) and normally developing students (N = 100) studying at the 5th grade level in Kocaeli, Turkey during the 2017-2018 and 2018-2019 school years. In order to determine students' attitudes towards science, science and technology lesson attitude scale was applied. According to the results of the study, while there was no significant difference in terms of "enjoyment" and "social content of science" from the science and technology lesson attitude scale factors, it was found that there was a statistically significant difference in favor of gifted students from the "scale total scores" and "desire to learn" factors ($p<0,05$). In the genetic dimension of the study, no statistically significant difference was found between the two groups in AR gene CAG polymorphisms. In the whole sample, there was no significant relationship between the AR gene CAG polymorphisms and the "scale total score" values.

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Introduction

Giftedness and Genetics

Gifted people have achieved great success throughout history. People who provide important developments in technical, scientific and social fields in societies are those who have superior brainpower (Çağlar, 2004). Specially gifted students show interest in different subjects compared to their peers and have a desire for detailed learning with a sense of curiosity (Taber, 2017). But the question is "Does being gifted always positively affect the attitude towards science?" Is it determined solely by IQ score, or can it be supported by genetic factors?" Thinking that cognitive abilities and intelligence are due to the best versions of genes, researchers have found a different sequence on the long arm of chromosome 6 than other humans (Asbury and Plomin, 2016). They noted that this sequence in the middle of the IGF2R gene differs in intelligent children. The existence of intelligence genes indicates that an inherited link between the IQ value and the genes (Ridley, 1999). Although different variations of intelligence affect the interests, skills, and

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attitudes of individuals in different areas, individuals with high IQ levels are defined as gifted. It is a simple approach to identify students with standardized test scores who can be described as gifted in the field of science (Taber, 2017). Science education has an important place in mental field education. The interests, desires, curiosity, and research feelings of gifted children in the field of science are signs of their future success (Tereci et al. 2008). However, in Turkey, there are only studies that examine the science attitudes of gifted students in terms of students 'gender, educational areas, class levels, and families' education level (Tereci et al. 2008).

Genetic differences seen in a population with a frequency higher than 1% are expressed as polymorphism. Polymorphisms are not causes of disease, but may be causes of susceptibility to disease. There are many genetic polymorphism studies conducted in diseases such as phenylketonuria, Alzheimer's, Prader-Willi Syndrome, William's syndrome, Down Syndrome, schizophrenia, psychosis, autism, dementia. Compilation studies based on intelligence focused on genetic polymorphisms in these diseases and mostly studied on the 2q, 6p, 7, 21, 22, X chromosomes. There are very few studies on genetic polymorphisms in intellectually gifted children (Celec et al. 2013; Durdiakova et al. 2013).

Celec et al. (2013) examined the polymorphisms in the Androgen Receptor (AR), Estrogen receptor (ESR), Sex Hormone Binding Globulin (SHBG) genes of (Intellectually gifted children) special talents between 2013-2015, and statistically significant results were determined. It was found by the same researchers that there was a significant decrease in the number of AR gene CAG repeats in children with special abilities (Intellectually gifted children).

The AR gene is a 10667 base pair gene with 8 exons on the Xq12 chromosome (URL1; URL2). It corresponds to a protein consisting of 920 amino acids (URL3). This gene is a hormonally regulated transcription factor that mediates a wide variety of biological processes (Liao et al. 2003). The functional polymorphism of the AR gene is known to have a higher DNA binding activity resulting in a stronger androgen signaling of shorter alleles. As the number of CAG repeats increases, the transcriptional activity of the androgen receptor functions as a transcription regulator (Celec et al., 2013). In two studies, the relationship between CAG polymorphism and cognitive abilities was examined, and it was reported that fewer CAG repeats will show a stronger androgen signal (Celec et al. 2013; Durdiakova et al. 2013).

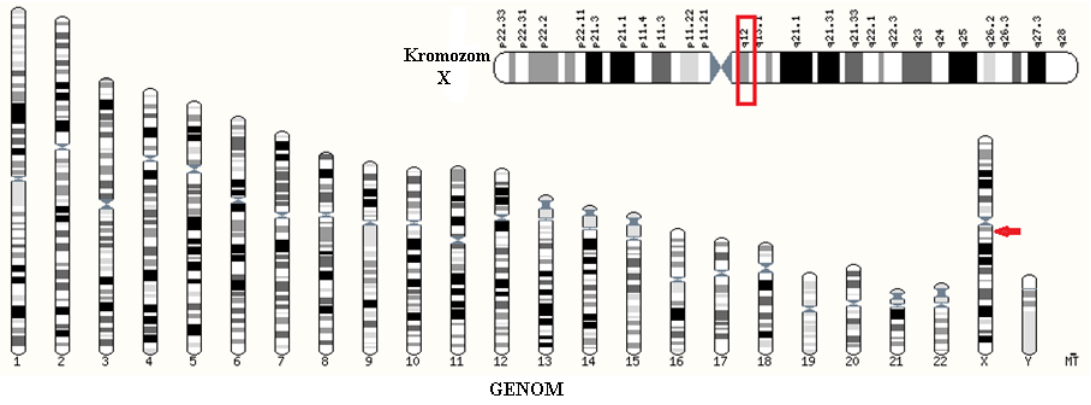

Photo 1

Location of the Androgen Receptor Gene in Human Genome (URL4)

Giftedness and Science Attitude

Studies on special talents and their attitudes towards science were examined. Among these studies, Tereci et al. (2008), a study on the gender, education levels, fields of education, educational status of the family and science attitude of the primary and middle school level students with special abilities who are studying at the Science and Art Center (SAC); (Orbay et al. 2010), the study examining the relationship between the gender, class levels, family education status and attitude towards science of gifted students attending SAC; the study by Keser and Kalender (2016) in which the attitudes towards the science of the students who continue the "support education program", "individual abilities noticeable program" and "special skills program" in SAC; and the study by Camcı Erdoğan (2013), in which the attitudes towards science were analyzed, with the sample of 11 specially gifted female students; draw the attention.

Within the world literature; Harty and Beall (1984), examined the attitudes towards the science of 25 gifted and 25 normally developing students at 5th grade in Indiana; Al-Hemaisan (1985) conducted on science achievement, attitudes toward, learning motivation, and divergent creativity on academically gifted or non-gifted male students in a middle school in Saudi Arabia; Afro-American middle school students' attitudes towards science were investigated by Yong in (1992); Caleon and Subramaniam (2008) investigated the attitudes towards science in terms of enjoying science, career preference and social content, with groups of students with medium, above-medium intelligence and

special talent; Bo-eul and Chi-soon (2014) compared between gifted and general elementry school students' scientific attidues and deree of satisfaction about school science lessonss of science in South Korea; studies appear before us.

In the studies conducted in SAC, it is seen that gifted students attending different stages of primary education are compared within their own sub-groups, generally examined in terms of their gender, family education status and their attitudes towards science, and studied with small samples. Similar to our work in the world, Harty and Beall's (1984) article appears, but it is seen that a very small sample is used.

Photo 2

Gifted Students in Science Acitivity Environment

Problem of Study

This research objective is to determine whether there is a relationship between this gene region and the attitude towards science by examining the attitudes of gifted students towards science and the AR gene CAG repeat polymorphisms in Kocaeli. This study is the first study in Turkey in which attitudes towards science and genetic research were carried out on gifted students, and it is thought that it will guide those who want to do research in this field in the future.

Materials and Methods

Research Design

This study was carried out by using the relational survey model in order to investigate the AR gene CAG repeat polymorphisms of gifted and normally developing students and to determine its relationship with their attitudes towards science. Survey models are research approaches that aim to describe a past or present situation as it exists. The event, individual or objects subject to the study are tried to be defined as they are (Karasar, 2007).

Participants

The research was conducted in Kocaeli province borders in 2017-2018 and 2018-2019 academic years. The study group consisted of 100 students randomly selected at the 5th-grade level and 100 students with normal development, a total of 200 students. The identification of gifted students was carried out by the Guidance Research Center (GRC), a department administered by Ministry National Education, with the WISC-R intelligence test, and those with an IQ level of 120 and above were included in the study.

Data Collection Tools

The study was conducted with two different data collection tools. These are:

Science and Technology Lesson Attitude Scale

The "Science and Technology Course Attitude Scale", which was developed, validity and reliability tests was done by Yaşar and Anagün (2009), was applied to 100 students with special talent and 100 students with normal development.

For 5th grade students, each item was evaluated with the five-point Likert scale, which is expressed as Strongly agree (5), Agree (4), Neither agree nor disagree (3), Disagree (2), Strongly disagree (1).

Data entries were made as positive sentences were valued from 5 to 1, negative sentences from 1 to 5. It was assumed that the students participating in the study behaved sincerely and objectively while answering the data collection tools. The highest 95 points indicate the most positive attitudes and the lowest 19 points indicate the most negative attitudes. Neither agree nor disagree option expresses neutral attitudes with an unknown direction. Scores below 57 points towards negative attitudes, scores above 57 points towards positive attitudes.

The five-point Likert-type Science and Technology Course Attitude Scale, developed by Yaşar and Anagün (2009), consisting of 19 items and three factors, was used to determine students' attitudes towards science. The validity and reliability studies of the scale were conducted on 849 fifth-grade students randomly selected in Eskişehir city center. Cronbach's alpha reliability coefficient was 0.89, KMO Barlett coefficient for structure validity was 0.3. As a result of the factor analysis, it was observed that the scale was gathered in three factors. The factors were named as pleasure, desire to learn and social content of science based on the literature (Yaşar and Anagün, 2009). The total Cronbach's alpha reliability coefficient of the scale for the sampling (N = 200) was calculated as 0.867.

Genetic Analysis

DNA Isolation, Polymerase Chain Reaction and DNA Sequence Analysis

In children in the 5th grade, 200 µl of saliva fluid was collected in sterile tubes 30 minutes after cleaning the mouth and teeth with a disposable toothbrush from 200 individuals, including 100 experiments (diagnosed with special talent) and 100 controls (with normal development). Saliva samples were kept in cold containers until they were brought to the laboratory for DNA isolation.

DNA isolation was performed using the EURx GeneMATRIX Tissue & Bacterial DNA Purification Kit (Gdansk Poland, Cat no. E3551) following the procedures recommended by the company. Primers for AR gene CAG repeat polymorphism were as follows: 5'-GCGCGAAGTGATCCAGAAC-3' (forward) ve 5'-CTCATCCAGGACCAGGTAGC-3' (reverse) (Durdiakova et al., 2013). 5x FIREPol Master Mix (Solis BioDyne) was used to prepare the PCR reaction mixture. PCR reaction mix 5x Master Mix: 6µl, 10 µM primer (sense): 0.5 µl, 10 µM primer (antisense): 0.5 µl Mold DNA: 2 µl were used. Bidistillated water was added to 30 µl for the PCR mixture of the gene region. PCR steps were involved: 4 min at 94°C (pre-denaturation), 35 cycles at 94°C for 45 s (denaturation), 45 s at 59,5 °C (annealing), 45 s at 72°C (extension), and 10 min at 72°C (final extension). The amplified AR gene CAG repeat polymorphism PCR products were then for 30 minutes at 100 volts in 1,5% agarose gel electrophoresis and visualized with a UV transilluminator by using Safe-T staining (ethidium bromide alternative).

PCR products were purified by the BM Lab in accordance with the kit procedures used with the ExoSAP-ITTM PCR Product Cleanup Reagent (Thermo Fisher Scientific, USA) purification enzyme. Sequence analysis was performed by using sense and antisense primers of the purified PCR products of the AR gene CAG repeat polymorphism. For the Sanger sequencing, the ABI 3730XL Sanger sequencing device (Applied Biosystems, Foster City, CA) and the BigDye Terminator v3.1 Cycle Sequencing Kit were used in the Macrogen Netherlands laboratory. Genotypes were determined by displaying with the chromas 2.6.6 program for the CAG repeat numbers of the AR gene.

Analysis of Data

Power analysis was performed using the G * Power 3.1.9.4 program to determine the sample number of the study. The study conducted by Celec et al. in (2013) on AR gene CAG repeat polymorphisms of specially gifted children was examined. The sample size they used in this study was found to be alpha = 0.05 and 1-Beta = 0.98 as a result of the power analysis performed by considering N1 = 67 (control) and N2 = 95 (experimental group). When the 1-Beta value was examined, it was seen that the total sample size of the study (N = 200) was a good value.

SPSS 22.0 software was used for statistical analysis. Kolmogorov-Smirnov test was conducted to look for the normal distribution of the numbers of AR gene CAG repeat polymorphism between the experimental and control groups. Then, the non-parametric test, Mann-Whitney U (M-W) Test was applied. The average of ranks and totals of ranks were determined and analysis was made at the level of p = 0.05.

Kolmogorov-Smirnov test was used for the normal distribution of the science lesson attitude scale according to the intelligence level. The numbers of AR gene CAG repeats of specially gifted and normally developing students were grouped and compared statistically with the total scores of the scale. For this, Celec et al. (2013), the CAG numbers were divided into 3 groups as 16-20, 21-24, and those containing 25 or more numbers. The groups are named as "CAG16-20, CAG21-24, and CAG25-". The Scale Code is divided into two groups as “19-56 and 57-95”, since scores above 57 points towards positive attitudes and scores below 57 for negative attitudes. Then, binary logistic regression was performed to determine the relationship between scale total score values and the number of AR gene CAG repeats and to calculate the risk ratios (odds ratios) at 95% confidence interval (CI).

Ethics Committee Approval

For the AR gene CAG repeat polymorphisms of the sample groups in the study, the permission of Kocaeli University Faculty of Medicine 2017/375 KÜ GOKAEK Non-Interventional Ethics Committee was obtained. Later, the approval of the Ministry of Education and the Governorship was obtained, dated 30.04.2018 and numbered 99332089-605.01-E.8616597. Then, the study was carried out by obtaining permission from parents and students. This study was supported by Kocaeli University Scientific Research Projects Unit (2018-105).

Results

In the first dimension of the study, which was conducted on two groups of students studying in the 5th grade with gifted sturdent and showing normal development, the groups were examined in terms of attitudes towards science. In the second dimension, genetic research was conducted and it was investigated whether there is a statistically significant difference between the groups in terms of the number of AR gene CAG repeats.

The results of the research regarding the science attitude scale applied to the gifted and normally developing groups are shown in Table 1.

Table 1
Mann-Whitney U (M-W) Test Results in terms of Factors of Science and Technology Course Attitude Scale of Students with Special Abilities (Gifted) and Normal Development

Factors	Group (n)	Rank Avg.	Rank Sum.	Median Value	Mean ± sd	U	p
Factor 1	Gifted (100)	100.72	10072	36	34.44±6.14	4978	0.957
	Normally developing (100)	100.28	10028	36	34.14±6.33		
Factor 2	Gifted (100)	114.32	11431.5	33	31.44±3.96	3618.5	**0.001***
	Normally developing (100)	86.69	8668.5	30	27.02±8.40		
Factor 3	Gifted (100)	100.05	10004.5	18	17.60±2.90	4954.5	0.909
	Normally developing (100)	100.96	10095.5	18	17.45±3.13		
(Scale Total)$_n$	Gifted (100)	110.3	11029.5	87	83.48±11.69	4020.5	**0.017***
	Normally developing (100)	90.71	9070.5	82.5	78.61±14.18		

Avg.: Avarage; sd: standard deviation; *statistically significant when p <0.05.

When Table 1 was examined, no statistically significant difference was found between the results of the gifted students and the students with normal development in terms of Factor 1 "enjoyment" and Factor 3 "social content of science" scores (U = 4978.00, p = 0.957 and U = 4954.50, p = 0.909 respectively). When factor 2 was analyzed in terms of "desire to learn" scores, it was observed that there was a statistically significant difference between the two groups (U = 3618.50, p = 0.001). While the factor 2 mean scores were 31.44 in the gifted group, it was 27.02 in the normally developing group; It is seen in Table 1 that the median values are 33.00 and 30.00, respectively. Considering the mean rank, it is understood that the attitudes of the gifted students are higher in terms of factor 2 than the students with normal development.

Table 1 shows that there is a statistically significant difference when gifted students and students with normal development are examined in terms of scale total scores (U = 4020.50, p = 0.017). While the mean of the total scores of the scale was 83.48, the average of the total scores of the students with normal development was 78.61. The median for gifted students was 87.00, while the median for students of normal development was 82.50. Considering the mean rank, it is understood that gifted students have higher attitudes towards science than students with normal development.

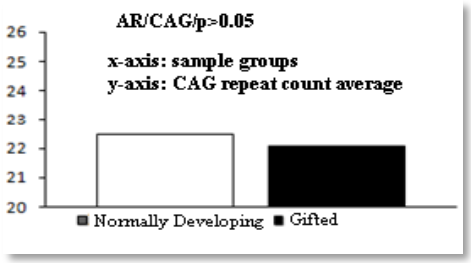

Figure 1
Bar Graph Showing the Average Number of AR Gene CAG Repeats in Individuals with Normal Development and Special Talents (Gifted)

Table 2
Findings Related to the Differences between the AR gene CAG Repeat Numbers of Gifted and Normally Developing Students

Group		Rank Avg.	Rank Sum.	Median Value	AR (CAG)$_n$ Avg.± sd		
Gifted	89	89.75	7987.50	22.00	22.45±2.98	3982.50	.302
Normally Developing	98	97.86	9590.50	22.00	22.07±2.91		

Avg.: Avarage; sd: standard deviation; *statistically significant when p <0.05

In the genetic dimension of the research; despite the repetition of the experiments, samples that were thought to be contaminated due to the problems experienced while taking samples or during laboratory experiments were not included in the study, and therefore, the study continued with 89 students with special talents and 98 students with normal development (Table 2). When Table 2 and Figure 1 are examined, it was found that there was no statistically significant difference between the group with special talents and the group with normal development (p = 0.302) and the median value was 22.00 in both groups.

Table 3

Frequency Distribution of Gifted and Normally Developing Students in terms of AR Gene CAG Repeat Polymorphisms

AR gene CAG Repeats	Gifted N=89 (%)	Normally Developing N=98 (%)	Total N=187 (%)
16-20	24 (27)	19 (19)	43 (23)
21-25	58 (65)	69 (70)	127 (68)
26-35	7 (8)	10 (11)	17 (9)

Table 4

Dual Logistic Regression Results Showing the Relationship between the Number of AR Gene CAG Repeats and the Total Scores of the Scale Towards Science and Technology Lesson Attitude

AR-CAG(n)	Scale Code (19-56) n=12 (%)	Scale Code (57-95) n=175 (%)	Crude values		Adjust values (Gender, intelligence level, number of siblings)	
			p value	OR (CI %95)	p value	OR (CI %95)
AR-CAG$_{16-20}$	2 (17)	41 (23)	-	-	-	-
AR-CAG$_{21-24}$	9 (75)	105 (60)	0.781	0.707 (0.061-8.168)	0.414	0.496 (0.093-2.662)
AR-CAG$_{25-}$	1 (8)	29 (17)	0.397	0.402 (0.049-3.307)	0.728	1.573 (0.122-20.219)

*statistically significant when p <0.05

The frequency of the AR gene CAG repeats in both groups was examined (Table 3). In total, students with 21-25 CAG repeats in the AR gene constitute 68% of our study sample, 16-20 CAG repeats constitute 23%, and students with a CAG repeat number between 26 and 35 are 9% of our study sample. Based on this, it was examined whether there was a relationship between the CAG repetition numbers and the scale total score values for science attitude. The related binary logistic regression analysis results are shown in Table 4. Scores below 57 points towards negative attitudes, scores above 57 points towards positive attitudes. The neutral score that can be obtained by the student who uses the expression "Neither agree nor disagree (3)" in all items of the science and technology lesson attitude scale was used as the threshold value. When Table 5 was examined, a statistically significant result could not be obtained in the analysis performed considering variables such as gender, intelligence level, and number of siblings, as well as between the number of CAG repetitions and scale total score values (p> 0.05).

Discussion

Every activity students do by putting themselves in the shoes of scientists and the experiments they carry out in the laboratory environment encourage them to have a positive attitude towards science. As a result of the diagnosis of gifted children, the difficulties students experience while adapting to the role assigned to them and the changes in their mood and environment, could affect the children. The problem of self-confidence in learning and developing science processes in science, combined with the daily challenges they face in class, can cause children to create prejudices against science. Difficulties of given science learning tasks can affect the social, psychological, and emotional dynamics of children. The experiences and these dynamics of normally developing children will not be the same. However, if the same conditions, environment, and experience are provided, similar results can be obtained in terms of attitudes.

Items in factor 1 measure students' ability to enjoy science and technology lesson. When the results were examined, there was no difference between the two groups of students in terms of enjoying science lessons. Orbay et al. (2010), in a study they conducted, investigated the attitudes of gifted students attending the science and arts center in Amasya towards science depending on variables such as their gender, education areas, class levels, and educational status of families. There was no statistically significant difference between the specified variables and gifted students' attitudes towards science.

In a study conducted by Cürebal (2004), it was reported that the 8th grade students' scores were higher than the 9th and 11th grade students' scores among the academic grade levels in terms of the factor of enjoying science lesson, and this difference was found to be statistically significant. It was stated by the same researcher that the science lesson in 8th grade is a lesson in which the most interesting and entertaining subjects are included. In our study, we found that there was no significant difference between two groups with the same grade level (5th grade) in terms of enjoying science lesson, that the same science course subjects were taught in formal education institutions, and at the same time, students were supported with concrete experiments and activities. It is thought that every student can enjoy science lessons regardless of their intelligence level. In a study conducted by Yong on African-American middle school

students, it was observed that students perceived science as interesting, entertaining, and enjoyed attending science classes (Yong, 1992).

Keser and Kalender (2016), in their study in terms of the attitudes towards the science of students who attend the "support education program", "individual abilities awareness program" and "special abilities program" in SACs where gifted students are educated, "special skills program" found a statistically significant difference between continuing students and those who attended the "support education program". They stated that the attitude scale scores of the students who attended the "special skills program" were higher than the scores of the other students, and they attributed these students to their intense desire to learn, their orientation to activities, experiences, and even branches in line with their interests. The fact that there is a significant difference between the results of gifted students and students with normal development in terms of Factor 2 "desire to learn" scores in our study ($U = 3618.50$, $p = 0.001$) is in parallel with the studies of Keser and Kalender (2016). It is known that individuals with special talent have high motivation and focus power in the field they are interested in (Akça et al. 2018). This result supports the curiosity of gifted individuals and their desire to learn by asking too many questions.

In our study, in terms of "Social Content of Science" (Factor 3) scores, no statistically significant difference was found between the results of gifted students and students with normal development (Table 1, $U = 4954.50$, $p = 0.909$). Caleon and Subramaniam (2008), analyzed the groups' attitudes towards science in terms of social content in their study, in which the sample was composed of average, above average and gifted students in terms of intelligence levels, and they did not find a statistically significant difference between the attitudes of above-average and gifted students.

In the study conducted by Cürebal (2004) in terms of the "Social Content of Science" factor in a total of 163 gifted students at four different grades (eight, high school preparatory, nine and eleventh grades), no statistically significant difference was found.

Harty and Beall (1984), in their study in Indiana, examined the attitudes of 5th-grade students with special ability (25) and normal development (25) towards science, and in terms of scale total scores, there was a slightly positive attitude among the gifted students between the two groups. Although they have a tendency to exhibit, they could not detect a statistically significant difference. Although there is a similar study with this study, the results obtained are different. Its; It is thought that it may arise from differences such as sample size, population, education system, curriculum contents, intelligence diagnosis methods, socioeconomic level, and technology. The sample size is 4 times the research done in Indiana. Harty and Beall (1984), used the "Iowa Tests of Basic Skills" (Hieronymus, Lindquist, and Hoover, 1979) tests for general abilities and the "Cognitive Abilities Test" (Thorndike and Hagen, 1979) tests for cognitive abilities. The same researchers thought that the procedures for selecting gifted students were not done correctly at that time.

Tereci et al. (2008), in a study by the gifted primary education I. and II. It has been observed that there is no significant difference between the total science attitude scores of the level students according to their gender, education levels, education fields, and educational status of the family. In this study, the sample group consists of gifted children and normally developing students. When the attitudes of individuals at normal development level and individuals with special talent are compared to science, it is seen in Table 1 that the scale average scores of the gifted individuals are higher in terms of the total scores of the science and technology lesson attitude scale. According to this research, it can be stated that gifted students have positive attitudes towards science. As a matter of fact, Tereci et al. (2008) states that students' attitude to the lesson will affect their success and participation rates. In the study of Camcı Erdoğan (2013), the sample of which was composed of 11 gifted female students, the attitude towards science was examined and it was stated that the students showed high attitudes in terms of scale total scores. Caleon and Subramaniam (2008), in their study with average, above average, and gifted student groups in terms of intelligence levels; Attitudes towards science were investigated in terms of enjoyment of science, career choice, and social content, and all attitude subscales gave significant results in terms of scale total scores. The study of Caleon and Subramaniam (2008), in which the attitude towards science is examined, supports the results of the scale total scores analysis of this research.

The relationship between the number of CAG repeats in exon 1 of the Androgen Receptor gene and the transcriptional activity of the androgen receptor is inverse. The higher the number of CAG repeats, the lower the transcriptional activity of the androgen receptor. Shorter alleles generate stronger androgen signaling and display higher DNA binding activity (Ding et al. 2004).

Celec et al. (2013), conducted a research on boys between the ages of 14-15 in Bratislava. They were "gifted" ($n = 95$-gifted boys, IQ = 143.2 ± 9.6) and control ($n = 67$, IQ = 112.5 ± 14, 8), performed DNA isolation by taking intraoral epithelium samples from the group. Then they studied 6 single nucleotide polymorphisms consisting of

different gene regions and CAG repeat polymorphism located in the exon 1 region of the AR gene. Although there was a small difference between the two groups in terms of CAG repeat numbers, they found a statistically significant result ($p<0.03$). Celec et al. (2013), no statistically significant result was found between the AR gene CAG repeat polymorphism between the "gifted" and "normally developing" groups (Table 2, Graphic 2, $p = 0.302$). This may be due to the differences in the distribution of polymorphisms between populations. For example, Ryk et al. (2011), reported that the eNOS gene -786> C promoter polymorphism in the Swedish population would increase 3 times more in bladder cancer patients, but in a similar study conducted in the Turkish population, it was observed that there was no statistically significant difference (Polat et al. 2016).

When the relationship between the number of all AR gene CAG repeats in both groups (Table 3) and the scale total score values for science attitude was examined (Table 4), there was a statistically significant difference between the number of AR gene CAG repeats and the scale total score values in attitude towards science (Table 4). No result was obtained. Similarly, a statistically significant result was not obtained in the analysis performed by adding the AR gene to CAG repeat numbers in variables such as gender, intelligence level, and number of siblings.

According to Asbury and Plomin, according to the information obtained from twin studies, there is a definite component between mathematics ability and genetics. Low mathematical ability may be affected by the same genes that affect normal variations in ability (Asbury and Plomin, 2016). While the intelligence level of twins is 20% similar in the mother's womb, the intelligence levels of non-twin siblings show a 5% similarity rate. The common point reached as a result of the studies is that approximately 50% of the IQ level is determined by inheritance, less than 5% is shaped by the environment shared with siblings - the family. No information has been found in the literature regarding the relationship between the gene and interest in science. In future studies, the interest in science, science ability, and different gene regions can be examined and contribution to the literature can be made.

Conclusion and Suggestions

It is very important to direct students to educational strategies that will enable them to become individuals who adopt a creative thinking style that can go beyond certain patterns and can use their potential at the top level. By developing multiple skill areas, the interests of students should be determined, and studies should be carried out to improve the skills of individuals who show high success in science.

As a result, according to the science and technology lesson attitude scale data in this study, no significant difference was found between gifted students and students with normal development in terms of the factors of enjoyment of science and the social content of science. A statistically significant difference was found in favor of special talents in terms of learning desire and scale total scores. In the genetic analysis, no statistically significant difference was found in AR gene CAG repeat polymorphisms between the two groups of students and their attitudes towards science.

In Turkey, no evidence of any genetic polymorphisms sample of the work created by the gifted children. There are only a few studies on this subject in the world. This study is the first genetic study conducted with gifted individuals in Turkish society.

In addition, it is the first study in which attitudes towards genetics and science were examined together. Studies on science ability and genetics will close the gap in the literature. Researchers interested in this field may be advised to study ESR2, SHBG, CYP19A1, CYP19A1, ESR1, SRD5A2 gene, that are thought to be related to intelligence, in a larger sample including parents or twins. In the future, revealing the genetic profiles of individuals with special talents in various societies and evaluating them by using both intelligence tests and genetic information may lead to new researches in this field.

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Compliance with Ethical Standarts

Conflict of interest. The authors declare that they have no conflict of interest. ***Statement of compliance with standarts of research involving humans as subjects.*** All applicable international, national, and/ or institutional guidelines for non-invasive clinical studies were followed.

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