

## A Componential Analysis of Gender Differences in Scientific Creativity

## Bilimsel Yaratıcılıkta Cinsiyet Farklılıklarının Bileşensel Analizi

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### Abstract

In this study, an investigation was carried out to explore if there were any gender differences in scientific creativity and its components. Participants included 704 sixth grade students who applied to the Education Programs for Talented Students (EPTS) at Anadolu University in the City of Eskişehir in Turkey. Of the total sample, 345 were female and 359 were male. Students' scientific creativity was measured using the Creative Scientific Ability Test (C-SAT). It measures fluency, flexibility and creativity and hypothesis generation, hypothesis testing and evidence evaluation. The analysis showed that male students scored significantly higher on hypothesis generation components of scientific creativity. Although male students had higher scores on flexibility, hypothesis testing and evidence evaluation components too, the differences between the groups were not significant. The findings shows that gender differences in scientific creativity in childhood and adolescence might result from differences in some particular processes.

**Key Words:** scientific creativity, gender differences, hypotheses generation, experiment design, evidence evaluation

### Öz

Bu çalışmada bilimsel yaratıcılık ve bileşenlerindeki cinsiyet farklılıkları araştırılmıştır. Araştırma, Üstün Yetenekliler Eğitim Programları (ÜYEP)'na başvuran 704 altıncı sınıf öğrencisi ile gerçekleştirilmiştir. Katılımcıların 345'i kız, 359'u erkektir. Araştırmada bilimsel yaratıcılığı ölçmek için Bilimsel Üretkenlik Testi (BÜT) kullanılmıştır. BÜT akıcılık, esneklik, yaratıcılık, hipotez geliştirme, hipotez test etme ve kanıt değerlendirmeyi ölçmektedir. Bilimsel yaratıcılığın bileşenlerinde cinsiyet farklılıklarını karşılaştırmak için bağımsız örneklem t-testi kullanılmıştır. Veri analizi sonucunda; hipotez geliştirme, akıcılık ve toplam yaratıcılık puanlarında erkekler lehine anlamlı farklar bulunmuştur. Hipotez test etme, kanıt değerlendirme ve esneklik becerilerinde erkeklerin aldıkları puanların ortalamaları kızların ortalamalarından yüksek olmalarına rağmen bu farklar anlamlı bulunmamıştır. Elde edilen bulgular bilimsel yaratıcılıkta ortaya çıkan cinsiyet farkının bazı becerilerdeki farklardan kaynaklanabileceğini göstermektedir.

**Anahtar Sözcükler:** bilimsel yaratıcılık, cinsiyet farklılıkları, hipotez geliştirme, hipotez test etme, kanıt değerlendirme

### Summary

**Purpose and significance:** Gender differences in creativity have been a controversial issue for a century. In some studies, researchers found no gender difference in creativity; whereas, in other studies researchers discovered that males had a higher capacity in creativity than did females. Furthermore, gender differences in scientific achievement, scientific productivity, scientific creativity and scientific careers were also explored. Results show that males usually

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outperform females. The seeming gender difference favoring man in Nobel Prizes is a prime example. Are there such differences in the components of scientific creativity? What subskills or components of scientific creativity might contribute to gender differences in general scientific creativity? Does a particular process cause gender differences in scientific creativity? Prior research focused on gender differences in general scientific creativity. In this study, we took a further step and examined gender differences in scientific creativity at a componential level. We used three components, hypothesis generation, experiment design (hypothesis testing) and evidence evaluation of scientific creativity to investigate gender differences. We expected to obtain some findings to shed light on gender differences in scientific creativity.

*Table x. Means and t-test Results*

		N	M	SD	df	t	p	Effect Size ( $\eta^2$ )
Hypothesis Generation	Female	345	1,72	1,646	693,762	- 3,090	,002*	,013
	Male	359	2,13	1,911				
Hypothesis Testing	Female	345	3,64	2,475	702	- 3,090	,172	
	Male	359	3,91	2,706				
Evidence Verification	Female	345	1,78	1,665	702	- 2,472	,014	
	Male	359	2,11	1,828				
Fluency	Female	345	8,23	5,136	681,937	- 3,214	,001*	,014
	Male	359	9,63	6,360				
Flexibility	Female	345	5,53	3,040	698,042	- 2,559	,011	
	Male	359	6,15	3,412				
Creativity	Female	345	6,97	3,950	691,453	- 3,047	,002*	,013
	Male	359	7,96	4,656				

**Method:** Research participants consisted of 704 sixth-grade students who applied to the Education Programs for Talented Students (EPTS) at Anadolu University in Eskisehir, Turkey. Of the participants, 345 were female, 359 were male. In the study, the Creative Scientific Ability Test (C-SAT) was used to measure students' scientific creativity. The C-SAT is composed of five subtests with five open-ended problems in the area of biology, chemistry, ecology and interdisciplinary science. It measures fluency, flexibility and creativity in hypothesis genera-

tion, hypothesis testing and evidence evaluation tasks. Research carried out on the psychometric properties of the C-SAT shows good to excellent reliability and validity evidences. In this study, we also examined its reliability and found Cronbach alpha coefficient to be .85 and interscorer reliability for fluency and creativity to be .96, and for flexibility to be .94. In data analysis we set the significance value at .008 as we used several t-tests at the same time.

**Results:** Results showed that male students scored higher on all components of scientific creativity. However, only the differences in hypothesis generation and fluency and creativity in total scores were found to be significant. The effect sizes were small. Differences in hypothesis testing and evidence evaluation components of scientific creativity were not significant. The table x shows means and standard deviations of the scores in all the components as well as the t-test results and effect sizes.

**Discussion and Conclusions:** Results show that males' higher performance on hypothesis generation might contribute to overall gender differences in students' scientific creativity. Once hypotheses are generated, males and females can show similar performance on experiment designs and evaluation of evidences obtained from experiments. Results also mean that males might be better performers on developing predictions and constructing cause and effect relationships as hypothesis generation requires predictions and posdictions from evidences.