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ARTICLE

# Unmasking Gender Stereotypes

## Middle School Girls' Perceptions of Scientists vs. Fashion Models

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**Abstract**
Gender stereotypes have long influenced societal roles and career aspirations, particularly in science-related careers. This study aims to explore and contrast entrenched gender stereotypes in young minds, focusing on middle school girls' perceptions of scientists and fashion models. The research involved 149 female students from two rural middle schools in Turkiye. Using a qualitative research design, participants drew and narrated scenarios involving a scientist and a fashion model as a married couple. Additionally, they selected known scientists from diverse images, offering insight into their recognition and perception of scientists. The findings reveal a strong persistence of gender stereotypes. Most students depicted scientists as male, drawing parallels to iconic figures like Albert Einstein, while fashion models were consistently portrayed as female. These stereotypes were evident in both drawings and narratives, with scientists often viewed as engaged in solitary, high-risk work and fashion models concerned with physical appearance and facing career challenges post-childbirth. A profound lack of recognition for female scientists among students further highlighted entrenched gender biases. This research underscores the resilience of gender stereotypes in shaping young girls' perceptions and career aspirations. It calls for reassessing educational approaches and societal narratives to foster a more inclusive and diverse representation in science fields. The study emphasizes the need for targeted interventions to dismantle stereotypes, paving the way for a future where career choices in science are based on interest and ability rather than gender.

## 1 Introduction

Societal roles and expectations, shaped by physical sex differences and cultural contexts, lead to the development of gender stereotypes, resulting in a division of labor that reinforces societal expectations about gender (Eagly & Wood, 2012). Evidence shows that both explicit and implicit occupational gender stereotypes persist; some professions are implicitly perceived as masculine due to social and cultural factors, even when they are explicitly rated as gender-neutral, indicating that traditional stereotypes remain ingrained despite changes in gender composition (White & White, 2006).

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The societal division of labor, which designates different tasks to men and women for perceived efficiency, entrenches gender roles by reinforcing stereotypes and the perceived naturalness of these roles, with men often assigned intellectual and high-status positions and women focused on appearance and nurturing (Eagly & Wood, 2012; Ridgeway & Correll, 2004). Gender stereotypes, specifically, are general beliefs regarding how typical women and men are expected to think and act in different social contexts (Browne, 1998). Previous research highlights the significant impact of gender stereotypes on the perception and evaluation of women, with relational factors often taking precedence over other criteria (Ellemers, 2018). Unlike men, women are frequently assessed based on their appearance rather than their achievements (Heflick et al., 2011). This undue emphasis on physical appearance persists even in contexts where it should be irrelevant, leading to the objectification of women (Cikara et al., 2011). Consequently, a woman's value is often linked to her physical looks, reinforcing traditional stereotypes and objectification (Rollero & Tartaglia, 2016). This objectification process can further influence the perception of women, emphasizing communal traits over agentic ones, thereby perpetuating gender biases.

Gender stereotypes, particularly concerning science careers, create significant barriers that may inhibit students' ambitions (Luo & So, 2023; Schmader, 2023). The persistence of outdated gender "roles" can suppress students' potential and hinder innovation within science-related fields, frequently dissuading women from entering high-status roles in mathematics and science (Lupaschuk & Yewchuk, 1998). During childhood and adolescence, masculine stereotypes of STEM, parental expectations for daughters, peer norms, and conflicts with personal goals can drive girls away from (Dasgupta & Stout, 2014). Gender disparities in STEM fields are significantly influenced by cultural stereotypes and the masculine environment prevalent in these fields, rather than differences in interests or abilities between genders (Cheryan et al., 2017). The pervasive stereotype of STEM as a predominantly male domain contributes to a sense of alienation for many women (Luo & So, 2023; Nosek et al., 2002). However, men are also underrepresented in traditionally communal or nurturing roles, an aspect of gender disparity that is frequently ignored (Croft et al., 2015).

Turkish culture presents a mix of supportive and restrictive factors that influence citizens' especially women's career aspirations and advancement (Aycan, 2004). Despite various laws promoting gender equality, Turkiye's socio-cultural and socio-economic structures are not adequately prepared for the desired changes, resulting in not desired progress in achieving gender equality (Artar & Fildiş, 2021). Despite their achievements in newly accessible public spheres, women's identities might still be defined by their familial roles and continue to view their self-worth in relation to their responsibilities within the family structure. These roles typically assign women primary responsibility for family care, including husbands, children, and parents, and deem any work that might jeopardize the family's welfare or honor inappropriate (Durakbaşa, 1998; Erguder et al., 1991). Miski Aydin et al. (2023) also argued that working Turkish mothers often bear the primary responsibility for childcare, which contributes to heightened levels of family-work conflict and stress, further emphasizing traditional gender roles. Alemdaroğlu (2015) argues that young women in urban Turkiye navigate the contradictions between escaping traditional femininity and maintaining respectability by strategically balancing modern aspirations and societal expectations. Consequently, societal expectations generally support women's participation in the workforce only if it does not interfere with their family duties.

The results of studies with Turkish women who had high status in their careers showed that even these women held gender-role stereotypes (Aycan, 2004). Özkan et al. (2017) discovered that college students' stereotypical perceptions of scientists remained unchanged regardless of their study fields, social sciences, or quantitative disciplines. Bian et al. (2017) reported that

girls as young as six question their gender's association with brilliance. Also, the findings of studies with only female students showed that even female students described mostly male scientists in their drawings (Özdeş & Aslan, 2019). Bilir and colleagues (2020) worked with 8th-grade students and found that all students drew a male scientist before intervention. Even after 8 weeks of argumentation-based intervention, only 30% of students drew a female scientist. Buck et al. (2002) observed that interactions with accomplished female scientists did not always change students' perceptions, indicating the strength of these stereotypes.

The Draw-A-Scientist Test (DAST) has been a pivotal tool in understanding the layered perceptions of scientists, especially among the youth (Chambers, 1983; Mead & Metraux, 1957). Originally designed to identify stereotypical elements in children's drawings of scientists, DAST has charted the evolution of these images over time. Early findings from Chambers revealed a stereotypical scientist image involving lab coats and eyeglasses. At the same time, subsequent research, such as Finson's review in 2002, confirmed the persistence of these images, predominantly male and Caucasian, although some shifts in perceptions were noted.

Considering these persistent stereotypes that disadvantage females and favor males in science-related careers, it is essential to investigate how such biases shape science-related attitudes and behaviors across genders. Building on previous research, our study takes a novel approach by combining drawings and narratives, juxtaposing the perceptions of a scientist against those of a fashion model within a crafted scenario. Most studies utilizing the DAST have primarily focused on examining students' perceptions of scientists, often uncovering stereotypical images that depict scientists as predominantly male, eccentric, and highly intellectual. While these findings have been crucial in highlighting the gendered nature of scientific careers, they present a limitation by concentrating exclusively on scientists, thus overlooking the wider range of societal influences that shape girls' self-concepts regarding various occupations.

This research seeks to delve into middle school girls' perceptions of scientists, comparing their images and narratives of scientists with those of fashion models to gauge the resilience of stereotypes from past decades. Fashion models, frequently portrayed in the media as symbols of beauty, glamor, and femininity, stand in stark contrast to the intellectual and masculine stereotypes associated with scientists. By incorporating this comparison, the present study aims to shed light on the dichotomous nature of gender roles and their impact on girls' career aspirations. Our study poses the following questions:

1. How do middle school female students perceive scientists versus fashion models, and how are these perceptions manifested in their narratives and illustrations?
2. Compared to their depictions of a fashion model, who is assumed to be wedded to a scientist, how do these students portray scientists?
3. To what extent do the students' drawings echo the gender and occupational stereotypes identified and documented in prior studies?
4. What are middle school female students' knowledge and perceptions of scientists from different backgrounds based on their choices of scientists as given on a table?

## 2 Literature Review

Historical studies dating back to the 1950s (Mead & Metraux, 1957) reveal that students often have stereotypical images of scientists: typically, an older male in a lab coat, surrounded by equipment, and conducting possibly hazardous experiments. To gauge these perceptions,

many global studies use the DAST, a method that captures visual representations of scientists, often paired with supplementary techniques like interviews.

In the wake of initial findings, many researchers endeavored to enhance the DAST's attributes to gather more consistent data. These efforts primarily revolved around refining the instructions provided or tweaking the method of analyzing the drawings. Consequently, this led to a multitude of updated iterations of the DAST, with notable revisions presented by Barman (1999), Farland (2006), Farland-Smith and McComas (2009), Finson et al. (1995), and Huber and Burton (1995). For instance, Finson et al. (1995) expanded upon Chambers' research to create a checklist for evaluating DAST drawings, named DAST-C, streamlining the identification and quantification of stereotypic components for data analysis. Farland (2006) investigated how historical, nonfiction books influenced elementary students' views on scientists using a modified version of DAST called mDAST. Compared to students who received only modular/kit-based instruction, those exposed to weekly trade books displayed a more diverse understanding of scientists, their activities, and settings. Recently, Lamminpää et al. (2023) introduced the Draw-A-Science Comic (DASC) method. They explored the benefits and drawbacks of employing comics to gather information on children's perceptions of scientists and science.

Over the last decades, numerous global studies using the DAST or its revised versions have consistently found students' stereotypical portrayals of scientists, confirming the typical images pointed out by prior indicators, albeit with some slight variations. Students consistently exhibit stereotypical perceptions of scientists across various studies, spanning diverse age groups and global contexts. Lebanese students, as highlighted by El Takach and Yacoubian (2020), primarily pictured scientists as Caucasian males in chemistry labs, a stereotype that strengthened in higher grades, aligning with the perceptions of teachers and textbook authors. Similar findings emerged from Hong Kong (Fung, 2002), Italia (Bozzato, et al., 2021), Romania (Thomson et al., 2019), South Africa (Meyer et al., 2019), and Turkiye (Kara & Akarsu, 2013) where scientists were typically perceived as male, even among female respondents. Ferguson and Lezotte (2020) reviewed studies from 2003 to 2018 utilizing the DAST-C to investigate students' stereotypes of scientists. They identified a prevailing image of the scientist as a middle-aged Caucasian male. Luo and So (2023) investigated the perceptions of STEM professionals, including scientists, engineers, and technologists, among upper elementary students in Hong Kong. The findings highlighted dominant gender stereotypes, with students predominantly portraying males in these roles. They linked scientists with labs, engineers with building construction, and technologists with technological products. Blagdanic et al. (2019) emphasized that even preschoolers already hold these entrenched views.

Finally, in Turkiye, Yontar Toğrol (2013) found that, despite more than half of the students being female, most students across various grade levels drew male scientists. Stereotypes such as working alone and wearing lab attire were also common in these drawings. Ivgin et al. (2021) found that middle schoolers often associated iconic figures like Einstein and Newton with the scientist image, predominantly portraying them as solo-working males in lab attire. Çermik (2013) also argued that students' primary image of a scientist was predominantly that of Einstein. These studies collectively highlight the deeply rooted and widespread nature of gendered scientist stereotypes across ages and regions.

### 2.1 Have Students' Views of Scientists Ever Evolved?

Recent studies illustrate a shift in students' perceptions of scientists, revealing a mix of evolving views and persistent stereotypes. Barman (1999) observed encouraging patterns

in students' drawings, with a decrease in mythical representations of scientists and a move towards more realistic portrayals. Additionally, there was a notable absence of symbols suggesting danger and secrecy. McCarthy's (2015) research indicated a notable change, with nearly half the students portraying scientists as female and the majority showing them as cheerful, countering the stereotype of the aloof scientist. Similarly, Ivgin et al. (2021) found that Turkish middle school students pictured scientists mainly as cheerful males. Emvalotis and Koutsianou (2018) found that Greek primary school students, using the DAST, often depict scientists as male figures in chemistry labs with lab coats and research symbols, with boys drawing more stereotypical images than girls. Interestingly, most girls illustrated female scientists, with no significant variations across grade levels. Similarly, Song and Kim (1999) discovered that Korean students generally have less stereotypical perceptions of scientists regarding gender and age, often depicting them as around 30, although male students predominantly drew older scientists. El Takach and Yacoubian (2020) found that students expressed positive attitudes towards science careers and viewed scientists favorably.

However, the prevalent image remained that of a Caucasian individual in a lab coat. Meanwhile, Miller et al. (2018) conducted a comprehensive review of 50 years of DAST research in the USA and found an enduring association of science with males. Though there was an uptick in illustrations of female scientists, older students continued to draw predominantly male figures, underscoring the resilience of certain stereotypes despite media and professional advancements. Similarly, Ferguson and Lezotte (2020) reviewed studies from 2003 to 2018 utilizing the DAST-C to investigate students' stereotypes of scientists. They consistently found scientists perceived as middle-aged, Caucasian males in lab coats working indoors. Sinclair et al. (2023) examined how scientists are depicted in illustrations across 18 science textbooks for grades K-8 in Texas using the DAST-C, revealing a shift towards younger scientists and diverse work environments. Despite these changes, the persistent portrayal of scientists as predominantly Caucasian males suggests that textbook imagery has not fully embraced the inclusivity needed to encourage minorities and females in science careers. However, certain stereotypes, like Mythic Stereotypes and hints of danger, were absent, indicating a potential need to revise the DAST-C.

### 2.2 Social Role Theory

Social role theory (Eagly, 1987; Eagly & Wood, 2012) posits that societal roles and expectations lead to the development of gender stereotypes. These roles, shaped by physical sex differences and cultural contexts, result in a division of labor that reinforces societal expectations about gender. For instance, in many industrialized societies, women are often seen in caretaking roles at home and in employment settings, leading to the stereotype that women are communal and nurturing. In everyday life, individuals perform these gender roles through specific social roles, such as being a parent or employee. Since gender roles seem to mirror the inherent traits of each sex, they are perceived as natural and unavoidable.

This theory emphasizes that gender roles are rooted in human evolutionary differences, such as men's larger size and strength and women's reproductive responsibilities, including pregnancy and nursing. These physical differences, combined with societal and cultural contexts, make certain tasks more efficiently performed by one sex over the other. Consequently, men's roles often involve tasks requiring physical strength, while women's roles are more aligned with nurturing and caregiving. Individuals enact behaviors consistent

with their gender roles through socialization processes. From a young age, men and women are socialized to develop personality traits and skills that align with societal expectations. Gender roles influence behavior through biological and social processes, including hormonal changes, self-regulation according to gender standards, and social regulation based on others' expectations. Thus, biology and culture work together to shape role performance (Eagly et al., 2000).

The division of labor in society, which assigns different tasks to men and women, further entrenches gender roles. This division is seen as functional for societal efficiency but also contributes to gender stereotypes and the perceived naturalness of these roles. These perceptions are influenced by societal roles that assign men to intellectual and high-status roles and women to roles emphasizing physical appearance and nurturance (Eagly & Wood, 2012; Ridgeway & Correll, 2004).

Eccles et al. (1990) argued that parents' gender-differentiated expectations contribute to the persistence of gender roles and stereotypes in society. Their study uses the expectancy effect perspective to explore how parents' perceptions of their children's competencies in areas like math and sports are often biased by gender stereotypes. It shows that parents tend to distort their perceptions based on their child's gender, attributing boys' successes to natural talent and girls' successes to effort. These biased perceptions affect children's self-confidence and choices, reinforcing gender differences in activities and academic pursuits. Early gender role socialization impacts girls' aspirations and interests, highlighting the need to address these biases to promote gender equality in various fields.

### 2.3 Theory of Circumscription and Compromise

In addition to social role theory, Gottfredson's theory of circumscription and compromise (Gottfredson & Lapan, 1997) provides valuable insights into the development of career aspirations. Gottfredson's theory asserts that gender plays a crucial role in children's early judgments about the appeal of various occupations. According to Gottfredson, individuals begin to eliminate career options early in life based on their self-concept, which is heavily influenced by societal expectations and gender stereotypes. This process, known as circumscription, leads children to rule out occupations they perceive as inappropriate for their gender. As they grow older, they engage in compromise, modifying their career goals in response to external constraints such as accessibility, availability, and social acceptability (Gottfredson, 1981). For women, this often means narrowing their aspirations to roles that align with traditional gender norms and avoiding fields perceived as male-dominated. Despite increased educational opportunities and shifting societal attitudes towards women's employment, the persistent influence of these early circumscription and later compromise processes limits the range of careers women consider, reinforcing occupational segregation and perpetuating gender inequality in the workforce.

Individuals form stereotypes partly through their own experiences. However, since stereotypes are ingrained in the collective beliefs and assumptions that societies hold about various people and groups, they also become part of society's shared knowledge (White & White, 2006). Hofstede (1980) argues that deeply ingrained societal norms and values shape behaviors and expectations within a culture.

The above theories underscore the importance of addressing both explicit and implicit biases to broaden career aspirations and challenge traditional gender roles. They are particularly relevant for this study, which focuses on how middle school girls might perceive scientists versus fashion models. In the Turkish context, traditional gender roles continue

to influence career choices and societal expectations, making it crucial to understand and address these biases.

### 2.4 Occupational Gender Stereotypes

Societal gender roles arise from traditional family and occupational functions, leading to attributes assigned to men and women based on observed behaviors (Eagly & Wood, 2012). Children internalize these roles through family expectations and parental attitudes towards gender-specific competencies (Eccles et al., 1990). Influenced by such stereotypes, parents might unconsciously bias their perception of their children's abilities (Eccles et al., 1990), potentially setting the stage for a self-fulfilling prophecy where children gravitate towards areas where they perceive themselves to be competent. This results in women being typically associated with communal, family-oriented, or subordinate roles, while men are viewed as agentic, involved in resource acquisition, or dominant, perpetuating entrenched stereotypes (Hentschel et al., 2019; Kuchynka et al., 2022). Conversely, individuals in STEM are often perceived as competitive, independent, and inherently brilliant (Carli et al., 2016; Cheryan et al., 2017; Diekman et al., 2017; Diekman & Steinberg, 2013; Leslie et al., 2015; Miller et al., 2018), pushing boys towards fields that value problem-solving and mastery and are seen as less people-oriented (Buck et al., 2002).

A recent study by León and Aizpurua (2023) found that young people in Spain still exhibit some level of traditional gender stereotypes, particularly around career choices, which influence their support for feminism and attitudes towards gender-based violence, underscoring the ongoing cultural challenges in addressing these stereotypes. Hancock et al. (2020) examined occupational stereotypes related to sexual orientation, gender, and prestige using a diverse participant sample. The study found that certain occupations, like fashion designer, hairdresser, and make-up artist, are strongly associated with being perceived as "gay jobs," if men are in these roles, while others, such as auto-mechanic and police officer, are seen as heterosexual. Gender stereotypes identified roles like surgeon, pilot, school and hotel manager, CEO, president, auto-mechanic, roofer as male-stereotyped and nurse, dressmaker, hairdresser, interior decorator, professional dancer, and child-care worker as female-stereotyped. In terms of prestige, occupations like surgeon and CEO are viewed as high prestige, whereas laborer and bellhop are seen as low prestige.

Similarly, Canessa-Pollard et al. (2022) investigated the development of occupational gender stereotypes in children, focusing on perceived gender ratios and competence beliefs. They found that young children strongly associate male-typed occupations with men and female-typed occupations with women, with the most stereotyped thinking in the youngest age group. While perceptions of occupational sex ratios remained stable across age groups, beliefs about competence became less male-biased with age. However, female-typed occupations, such as nurse, hairdresser, and dancer, continued to be viewed as areas where women were more competent, indicating persistent gender stereotypes. In parallel to Canessa-Pollard and colleagues' finding, Solbes-Canales et al. (2020) indicated that children as young as 4 years old in Spain have internalized strong gender stereotypes, with boys and girls rigidly associating certain traits and professions with specific genders.

Concerningly, college women, including those in math-intensive fields, tend to associate science and mathematics with negative stereotypes (Nosek et al., 2002). Similarly, Barth et al. (2015) explored how gender roles and occupational stereotypes shape career interests in college STEM students, revealing that men favor "masculine-stereotyped" occupations regardless of goal affordance, while women prefer higher-salary jobs, highlighting

the significant influence of traditional gender roles and job compatibility perceptions on career choices. Jaoul-Grammare (2024) investigated the career perceptions of schoolchildren and students, revealing that while prestigious occupations like astronauts are generally perceived as mixed-gender, those requiring scientific training are still viewed as male-dominated. Girls rated professions such as lawyers, veterinarians, nurses, and midwives as highly prestigious, while boys preferred roles like airline pilots, professional sportsmen, and engineers. Dream job choices also varied across genders and were influenced by media and societal norms. Boys often aspired to become professional athletes, video game designers, or secret agents, whereas girls dreamed of careers as artists, decorators, influencers, or fashion designers.

Despite efforts to modernize and promote gender equality, deeply ingrained gender stereotypes persist in Turkiye, with women often described as emotional and self-sacrificing and men characterized as strong and ambitious, reflecting the traditional views and cultural norms that continue to shape societal expectations. Sakallı-Uğurlu et al. (2018) aimed to present how undergraduate students describe women and men and to generate themes from these descriptions. They found that women were most commonly described with traits like emotional, sensitive, self-sacrificing, easily offended, and beautiful, while men were often described as strong, angry, rational, and ambitious. The findings highlighted that gender stereotypes in Turkiye are consistent with traditional views, emphasizing communal traits for women and agentic traits for men. Çuhadaroğlu (2021) demonstrates that despite holding generally egalitarian attitudes, university students in Turkiye still perceive significant gender-based disparities, such as men having more behavioral freedoms and women facing social disadvantages, underscoring the need to address persistent gender stereotypes and societal biases.

### 2.5 Stereotypes in Media and Textbooks

There are several factors that may impact cultural gender roles designated for women. Stereotypes are frequently reinforced by the images and language employed in magazines and other media, particularly in terms of gender representation, manifesting explicitly through body figures, occupations, and settings associated with each gender, or implicitly through subtle postures, demeanors, gazes, and movements (Nam et al., 2011). These platforms can often propagate negative and misleading perceptions about certain groups of people. Girls encounter media depictions that emphasize traditional feminine norms. Steinke's analysis of female scientists and engineers in films revealed that, despite their high-status roles, there was a focus on appearance and romantic subplots, reinforcing gender stereotypes (Steinke, 2005). Similarly, Signorielli (2009) revealed that prime-time television from 1997 to 2006 often portrayed women in stereotypical roles, significantly underrepresenting them in professional and prestigious occupations compared to men.

Women were more frequently depicted in nurturing, caregiving, or domestic roles, reinforcing traditional gender stereotypes. Massoni (2004) analyzed 1992 issues of Seventeen magazine and found that the magazine typically portrayed entertainment careers as prestigious, positioned men as dominant in the workforce, and presented fashion modeling as a glamorous and attainable profession. This portrayal reinforces the stereotype that women's work should be centered around physical appearance. The study also highlights the disparity between the magazine's portrayal and the reality of the modeling industry, where opportunities are scarce and often less lucrative.

Children's magazines were no different from other magazines in this respect. Spinner et al. (2023) investigated gender stereotypes in print magazines for children across two studies and found that magazines aimed at boys or girls featured gender-stereotypic colors and characters. Girls' magazines displayed no speaking characters and more appearance-related words. They also found that girls' magazines emphasized fashion and home, advised seeking adult help, and included fewer educational activities, while boys' magazines focused more on job-related themes.

In the Turkish context, media portrayals similarly perpetuate gender stereotypes. Arslan (2015) examined gender portrayals in Turkish television commercials, revealing that female characters are often associated with domestic products, seen in home settings, and portrayed passively, while male characters dominate professional roles and are more physically active. Arslan and Koca (2007) found that only 6.05% of sports articles in Turkish daily newspapers were devoted to female athletes, highlighting the gendered nature of sports coverage.

Gender stereotypes can be also seen in advertisements related to family-care responsibilities. For example, Alabay (2023) analyzed the visual and linguistic elements of diaper commercials in Turkiye, uncovering significant gender stereotypes, with most commercials voiced by women and depicting women primarily in domestic roles such as shopping and hosting guests. Schools also contribute to this dissemination (Jaoul-Grammare, 2024). Kasa & Şahan (2016) analyzed the texts and images in primary school Turkish textbooks (grades 1–4) published by the Ministry of Education, revealing that the textbooks contain significant gender stereotypes, with men often depicted in roles requiring strength and economic responsibility while women are shown primarily in domestic roles and child-rearing, reinforcing traditional gender roles and disparities.

Although the Turkish science curriculum has been updated several times over the past 20 years, the portrayal of scientists in textbooks has not yet reached the desired level of diversity and balance. For instance, Laçin-Şimşek's investigation into the 2004 Turkish middle school science curriculum revealed that out of 78 scientists mentioned, only two were women, with one being the widely recognized Marie Curie (Laçin-Şimşek, 2011). Similarly, Özdemir (2022) analyzed the gender, origin, and life stories of scientists in middle school science textbooks within the 2018 updated curriculum. The findings showed that these textbooks predominantly feature male and foreign-origin scientists, with minimal representation of female and local scientists. This persistent imbalance could lead to gender- and nationality-based misconceptions among students, underscoring the need for a more balanced and inclusive representation of scientists in educational materials.

## 3 Methodology

A qualitative research design (Merriam & Tisdell, 2015) was adopted, utilizing a modified version of the Draw-A-Scientist Test (DAST), initially developed by Chambers in 1983, for primary data collection. The modifications included prompting students to draw a scientist and a fashion model, each responding to a specific scenario. Additionally, a table featuring images of scientists from various backgrounds and ethnicities was used to evaluate students' awareness and attitudes towards diversity in the scientific community. This method aimed to explore implicit beliefs and biases about the profession and to challenge or reinforce the common stereotypes associated with scientists.

### 3.1 Context and Participants

The data for this study were gathered from two distinct public middle schools situated in separate counties of a northeastern city in Turkiye. The first institution was nestled in a rural village, characterized as a small-scale school with a total middle school population of 55 students. The second institution, a vocational school inclusive of both middle and high school levels, was also located in a rural area and exclusively educated female students. This school, slightly larger in scale, had 190 students enrolled in its middle school programs.

The study was conducted by the instructor of a graduate-level course on the nature of science, who is also the first author of this study, along with master's students enrolled in that course. Two of the graduate students were teaching science at separate public middle schools located in different districts of a Northeastern city in Turkey. Data was collected from these two schools due to the convenience of accessing their classrooms, as the graduate students were directly involved in teaching at these schools. Thus, convenience sampling (Etikan et al., 2016) was employed to collect data from 149 female middle school students residing in the neighborhoods of these schools. The participants ranged from the 5th to the 8th grade. The focus on female students was twofold. First, there needs to be more research in the science education literature that concentrates exclusively on female students' perceptions of scientists. Second, research indicates that girls as young as six question their gender's association with brilliance (Bian et al., 2017), and they tend to associate science with negative stereotypes (Nosek et al., 2002).

### 3.2 Data Collection

Three different data tools were used to increase the validity and reliability of the study. Below is the description of each instrument in detail.

1. Narrative framework: a scientist and a fashion model

   Students were given a narrative framework involving a married couple: a scientist and a fashion model. In this scenario, one spouse was keen on having a child, while the other opposed the idea. The specifics, such as their genders and which partner did not want the child, were intentionally omitted. Students faced the challenge of weaving their own stories around this premise, delving into why the scientist or the model might resist parenthood. They were expected to characterize these individuals in their narratives, highlighting gender, occupational hurdles, and social dynamics. The purpose of this activity was to explore students' viewpoints and potential preconceived notions regarding the daily lives of scientists compared to those from distinct professional backgrounds. For this storytelling task, no time boundaries were set.
2. Illustrations of the scientist and the model

   Each student was asked to create illustrations of the scientist and the model described in their stories to enrich the data collected from the students' narratives. This approach was adopted to gain a more comprehensive understanding of their perceptions and interpretations. Individual sheets were distributed for each of the two drawings to facilitate organization.
3. Scientist recognition table

Third, the study presented students with a table that displayed images of actual scientists, each paired with a box for responses. The students were tasked with marking a checkmark next to the scientists they recognized and believed to be in that profession and a plus sign next to those they neither recognized nor associated with being scientists. The selection included 40 scientists—20 male and 20 female—from diverse ethnic backgrounds such as European/White, African American, and Asian. These individuals varied in terms of the historical periods they belonged to (contemporary or ancient), the scientific disciplines they specialized in, and their physical appearances, aiming to ensure a comprehensive representation of diversity.

### 3.3 Data Analysis

The data analysis followed a systematic and multi-phase approach to ensure accuracy, comprehensiveness, and reliability. A content analysis method, as described by Elo and Kyngäs (2008), was applied to examine the students' narratives and illustrations. The analysis process involved five researchers working collaboratively to enhance the reliability of findings and to cross-verify interpretations.

### 3.4 Narrative and Illustration Analysis

The analysis began with all researchers jointly reading a subset of student narratives and examining their corresponding illustrations. During this initial phase, the team identified key stereotypical indicators to focus on, including gender representation, physical characteristics, occupational settings, and daily routines. Particular attention was paid to the gender ascribed to the scientist and fashion model roles, as well as the reasons provided for their decisions regarding parenthood. These indicators were guided by findings from previous DAST studies (e.g., Ferguson & Lezotte, 2020; Finson, 2002, 2003), emphasizing the prevalence of gendered representations in students' depictions of scientists. This collaborative process ensured that all researchers had a shared understanding of what to consider when analyzing the data.

Following this calibration phase, the narratives and illustrations were evenly divided among the five researchers. Each researcher independently analyzed their assigned narratives, systematically coding stereotypical indicators and recording findings in a shared analysis table. After completing the initial coding, the researchers conducted a secondary analysis of the illustrations, meticulously reviewing visual elements such as the gender of the depicted characters, physical features, professional settings, and included objects (e.g., tools, symbols, equations). The focus on these specific visual indicators was informed by prior DAST studies, which underscore their importance in revealing underlying stereotypes and gender norms (Finson, 2002).

After completing their individual analyses, all researchers convened to discuss their initial observations, resolve any discrepancies in coding, and ensure consistency across the dataset. Through collaborative deliberation, key themes and patterns were identified, including the descriptions of characters' work environments, the reasons for opting out of parenthood, and recurring visual elements in the illustrations. These findings were then categorized, and the frequency and percentage of each identified code were presented using visual aids such as charts and tables for clear and effective communication.

### 3.5 Scientist Recognition Table Analysis

The next stage of analysis focused on the students' selections from the "pick the scientist" table. This table featured images of 40 scientists, and students were tasked with marking known or presumed scientists with a check (✓) and those unrecognized or not believed to be scientists with a cross (X). Two researchers independently analyzed these responses, systematically tallying the checkmarks and crosses for each scientist and computing their respective percentages. Instances where students left a scientist unmarked were also documented separately for male and female scientists to identify potential gender-based patterns.

To gain deeper insights, the recognition scores for each depicted scientist were reviewed by all researchers collectively. This analysis revealed trends based on gender and cultural background. For instance, male scientists, particularly historical figures such as Albert Einstein and Aziz Sancar, were frequently recognized. In contrast, female scientists, including renowned figures like Marie Curie and contemporary professionals such as Betül Kaçar, were less often identified. Additionally, scientists who deviated from Western norms, such as Andrew Z. Fire and Shinya Yamanaka, were less frequently recognized, highlighting implicit biases in student perceptions and the influence of cultural and racial stereotypes on their recognition patterns.

Recognizing potential limitations inherent in the DAST methodology—such as the influence of students' artistic ability on drawing quality and subsequent interpretation—the study incorporated supplementary narratives to provide context and depth to the illustrations (Reinisch et al., 2017). This multimodal approach allowed for a more comprehensive understanding of students' perceptions by triangulating findings from both narratives and visual data. In cases where ambiguity arose in interpreting details such as gender or work environments, researchers referred to the accompanying narratives for clarification. When additional clarification was required, students were personally asked to explain their drawings or elaborate on their narratives.

To further enhance the validity and reliability of the analysis, the study employed researcher triangulation, using multiple data sources and collaborative coding to cross-verify findings. This approach ensured that the analysis captured a nuanced understanding of the students' perceptions while mitigating potential biases in data interpretation.

## 4 Findings

This segment delves into the outcomes, systematically arranged in alignment with the research queries posed in the study.

### 4.1 Students Narratives About Scientists and Fashion Models

The initial step involved assessing the gender-based characterizations that students attributed to both the scientist and the fashion model in their narratives. Figure 1 clarifies this data, showing that 132 out of 149 students depicted the scientist as male, while the fashion model was consistently portrayed as female. This indicates that approximately 89% of the students adhered to a male representation of a scientist. Only a tiny number, precisely four

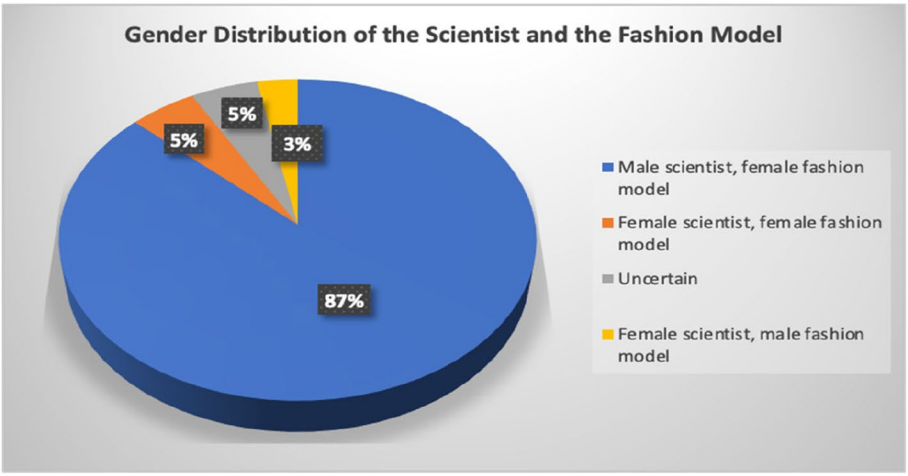


**Fig. 1** Gender representation of scientists and fashion models in student narratives

**Table 1** Rationale behind the decision of scientists or fashion models to forego parenthood as perceived by students

| Factors driving decision | Scientist (*f*, %) | Fashion model (*f*, %) |
|---|---|---|
| Concerns over physical appearance alterations | 0 | 31 (21%) |
| Occupational demands or worries regarding career progression | 30 (20%) | 40 (27%) |
| Apprehension about heightened responsibilities | 6 (4%) | 13 (9%) |
| Prospects for child's occupational choices | 6 (4%) | 3 (2%) |
| Miscellaneous concerns (economic challenges, health issues, etc.) | 11 (7%) | 17 (11%) |

students, reversed these roles, depicting the scientist as female and the model as male. The rest of the students assigned the same gender to both roles or did not specify gender in their narratives.

### 4.2 Subsequent Analysis of Students' Perspectives

Following the initial findings, the study delved deeper to understand the rationale behind students' depiction of the scientist's or fashion model's reluctance to have children. Reasons were systematically tabulated, commonalities identified, and codes established for recurring themes. The compiled results are presented in the table below.

From Table 1, it is evident that students' most prevalent reasoning regarding the reluctance of scientists or fashion models to have children centers on the fashion models' apprehensions about physical appearance post-childbirth, accounting for 21%. Put simply, students believe that fashion models fear the potential changes to their physiques after becoming mothers.

The following significant rationale, with roughly equal weight for both professionals, revolves around their work demands: 20% of students felt that the high-intensity nature of scientists' jobs, often requiring extended hours in the laboratory, left them with little to no

family time. Similarly, 15% felt that fashion models faced demanding work schedules that might be incompatible with child-rearing.

A connected sentiment, expressed by 12% of students, delves deeper into the career implications for fashion models post-childbirth. They opined that models might face difficulties continuing their profession or might experience reduced job offers, partly due to potential physical changes following childbirth. Another noteworthy concern was the heightened responsibility accompanying parenthood. According to the students, scientists and fashion models might dread the added burdens and complexities of balancing work with child-rearing duties.

A less dominant yet intriguing insight from the students concerned the prospective career paths of the offspring. Some believed that fashion models were wary of their children opting for science careers, anticipating that they would spend endless hours in labs, much like their scientist counterparts.

Less commonly cited in students' narratives were reasons about financial challenges and health issues. We grouped these varied rationales under the umbrella term "other reasons." Below is an illustrative excerpt highlighting a fashion model's concerns about potential job loss. In this narrative, the scientist endeavors to devise a machine to aid the fashion model in child-rearing tasks.

> Once upon a time, a male scientist, Ali, and a female fashion model, Busra, were married. Ali wanted to have a child, but Busra did not want to. Busra did not wish to have a child because she loved to walk on podiums and was scared of losing her job after giving birth. Ali had a brilliant idea to persuade Busra. He started to invent the intelligent machine that would carry baby food and the baby together and feed the baby when needed. (S55)

The excerpt below is similar to the previous example, as the model fears gaining weight and getting fired.

> My name is Ece, and I'm a female fashion model. I am married to Serhat, whom I met in France three years ago. Serhat works in a lab he created. He is keen on having a child, but the idea troubles me. As a fashion model, my boss would let me go if I weighed over 50 kilograms. (S11).

The excerpt below exemplifies the fashion model's anxiety about a child's future career. She thinks that her husband [the scientist] does dangerous experiments and so will her child.

> Once upon a time, a male scientist and a female fashion model were married. The scientist was engaged in high-risk experiments, including splitting an atom, delving into methods to travel to the Earth's inner core, and crafting potent solutions. He yearned for a child, but his wife, the fashion model, hesitated. She feared their child might be drawn to a science-oriented profession, viewing her husband's endeavors as perilous. (S22)

As seen in the excerpt below, many students emphasized in their stories that the laboratory was a dangerous place for a child.

> Once upon a time, a male scientist and a female fashion model were married. The fashion model wished to have a child, while the scientist did not want to. The scientist was scared that the laboratory would be dangerous for the child. Also, he did not want the child to go to podiums with their mom. (S114)

It was also common in stories that students mentioned scientists were brilliant but ugly while models were beautiful but not as bright as scientists:

> Once upon a time, a male scientist and a female fashion model were wed. Due to the demanding nature of his job and financial concerns, the scientist was reluctant to have a child. Attempting to persuade him, the fashion model said, 'What if we have a child as brilliant as you and as beautiful as me?' Unswayed, the scientist responded, 'What if she turns out as unintelligent as you and as unattractive as me?' (S130)

Our initial inquiry sought to understand middle school girls' perspectives on scientists, specifically how they visualized their daily lives in self-penned narratives. From the data, a significant majority (89%) depicted scientists as male and contrasted them with female fashion models regarding gender roles. When probed for reasons behind a scientist's or fashion model's reluctance towards parenthood, students often leaned on prevalent gender stereotypes or profession-specific traits. For instance, many believed scientists were engrossed in their labs, constantly engaging in high-risk experiments, leaving them with minimal family time. Some also felt that scientists desired offspring to inherit their intellectual prowess. On the flip side, the primary concern for fashion models, as perceived by students, was the potential compromise on their physical allure, resulting in anxieties about career prospects post-childbirth.

### 4.3 Students' Depiction of Scientists vs. Fashion Models

The illustrations crafted by the students notably lean on certain preconceived notions, as evidenced in Table 2. Each depiction showcased scientists with Caucasian features and Western attire. Interestingly, many of these renditions bore a striking resemblance to the iconic figure of Albert Einstein, as illustrated in Fig. 2. The patterns observed in the drawings suggest a prevailing influence of stereotypical imagery on the students' perception of scientists. Comparing these images with their depictions of fashion models could provide a deeper understanding of how gender and occupational stereotypes intersect in young minds.

Stereotypical features included crazy/untidy hair (48%), wearing a lab coat (42%), and wearing goggles/glasses (34%), as seen in Fig. 3. In the illustrations provided, it was evident that many students perceived scientists as having a messy and unkempt appearance.

**Table 2** Physical characteristics of scientists as illustrated by students

| Physical characteristics of scientist | Frequency (*f*) | Percentage (%) |
|---|---|---|
| Caucasian (white skin) | 149 | 100% |
| Crazy/untidy/frizzy hair | 87 | 58% |
| Lab coat | 62 | 42% |
| Smiling face | 53 | 36% |
| Goggles | 51 | 34% |
| Well-groomed hair | 24 | 16% |
| Beard/mustache | 20 | 13% |
| Casual/sportswear | 12 | 8% |
| Bald/sparse hair | 10 | 7% |
| Medical mask | 10 | 7% |
| Hat/helmet | 6 | 4% |

**Fig. 2** S018

Contrastingly, their depictions of fashion models showcased them as epitomes of beauty, typically adorned in elegant long dresses, bedecked with jewelry, and meticulously styled with makeup, as illustrated in Figs. 4 and 5. This highlights the prevalent stereotypes and cultural perceptions of these two professions.

A closer inspection of the drawings depicting fashion models revealed recurring attributes. For instance, 54% of students portrayed the model wearing a dress, while 53% illustrated the model with long hair. Other frequently observed characteristics encompassed makeup, high heels, full lips, jewelry and accessories, a smiling demeanor, skirts, a slender physique, and hair styled in a bun. These recurrent features are itemized in Table 3.

Many students characterized scientists as unattractive and elderly, while models were typically described as beautiful, well-maintained, and youthful in their narratives. For instance, student S53 portrayed the fashion model as an attractive 22-year-old weighing 52 kg with long hair. In contrast, she depicted the scientist as bald, bespectacled, sporting facial hair, 58 years old, and weighing 78 kg. While some students refrained from using explicit descriptors regarding age in their stories and illustrations, the imagery conveyed their perceptions. As evident in student S63's artwork, the scientist appeared noticeably older than the fashion model, as illustrated in Figs. 6 and 7.

An intriguing observation from the drawings was that several students depicted the scientist and the fashion model donning masks. This likely reflects the impact of the

**Fig. 3** S020


COVID-19 pandemic, indicating its profound influence on students' understanding and perceptions of contemporary professional environments. Figures 8 and 9 exemplify these illustrations, showcasing characters with masks covering their faces.

Students were not specifically directed to illustrate the environments surrounding the scientists and fashion models. Consequently, many depictions focused solely on portraying individuals. A significant 58% of these drawings could not be conclusively categorized as laboratory or outdoor scenes and were thus classified as "uncertain." The majority (37%) of

**Fig. 4** S033

the categorized drawings depicted indoor and laboratory settings. Only a small proportion, 5%, of the illustrations displayed scientists in outdoor conditions, as detailed in Table 4.

Upon a detailed analysis of the depicted working environments, it is evident that students had preferred objects they often incorporated into their illustrations, as illustrated in Table 5. Predominantly, laboratory supplies emerged as a recurring theme in these drawings. A significant portion, 86 students (58%), chose to include laboratory essentials like test tubes, beakers, microscopes, and chemicals in their artwork.

Following laboratory supplies, students more commonly included laboratory cabinets and study desks (32%). Other widely used objects were bulbs, computers, things related to space studies such as telescopes and stars, books, magnifiers, animals, formulas, and equations. Figures 10 and 11 are good examples of pictures with formulas and equations.

**Fig. 5** S141

**Table 3** Physical appearance of fashion models as depicted in students' drawings

| The physical appearance of the fashion model | Frequency (*f*) | Percentage (%) |
|---|---|---|
| Dress-skirt | 98 | 66% |
| Long hair | 79 | 53% |
| Makeup/manicured nail | 62 | 42% |
| High heels | 47 | 32% |
| Full lips | 39 | 26% |
| Jewelry and accessories (earrings, necklaces, crowns) | 39 | 26% |
| Smiling face | 27 | 18% |
| Fit and slender physique | 16 | 11% |
| Hair styled in a bun | 16 | 11% |

While most students leaned towards portraying scientists in traditional, stereotypical environments, one student, identified as S149, deviated from the norm. Her illustration provided a richly detailed working setting for the scientist. In her depiction, the scientist appeared to be working indoors, likely in a study room, surrounded by conventional and unconventional objects. She incorporated non-traditional elements such as musical instruments, a cat, and family photographs adorning the walls. Furthermore, her representation

**Fig. 6** S113

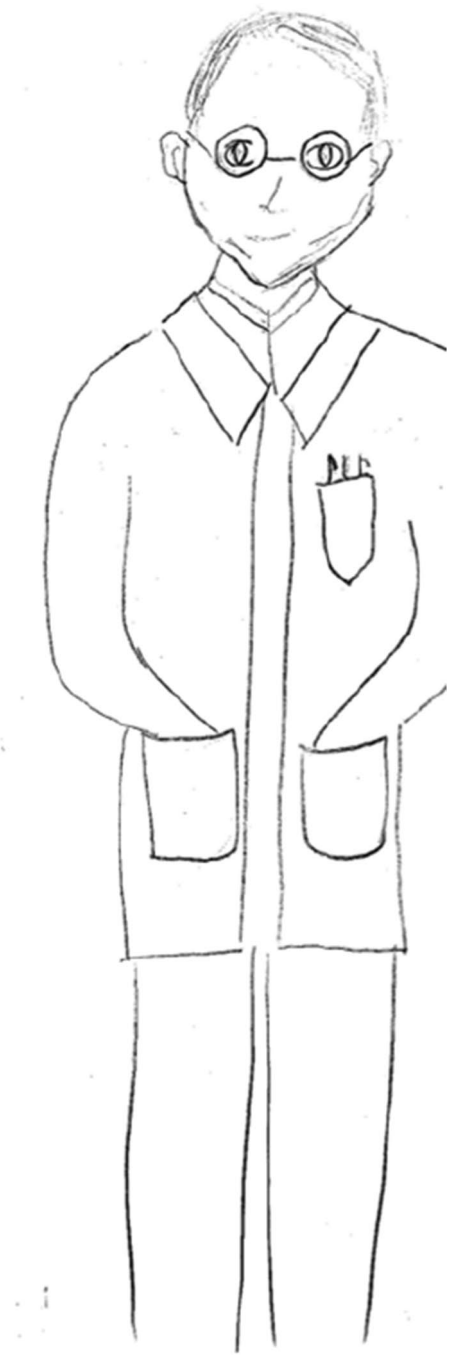

**Fig. 7** S113

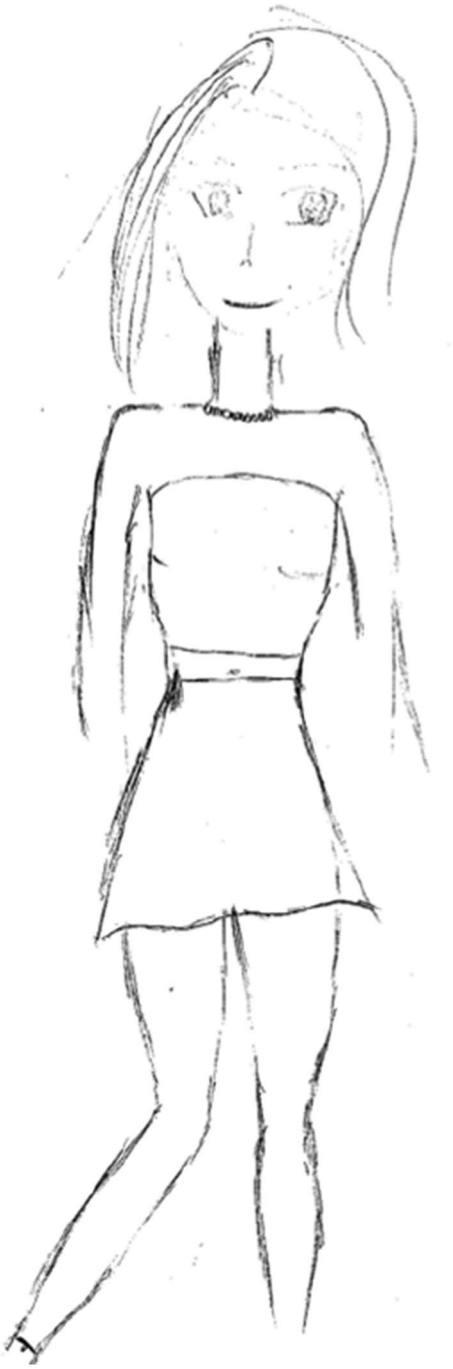

**Fig. 8** S90

**Fig. 9** S90

**Table 4** Working environment of the scientist

| Working environment | Frequency (*f*) | Percentage (%) |
|---|---|---|
| Indoor environment (e.g., laboratory) | 55 | 36.91% |
| Outdoor environment | 8 | 5.37% |
| Uncertain | 86 | 57.72% |

**Table 5** Objects in the working environment of the scientist as depicted in students' drawings

| Objects | Frequency (*f*) | Percentage (%) |
|---|---|---|
| Laboratory supplies (beaker, tube, microscope, chemicals, etc.) | 86 | 58% |
| Study desk and laboratory cabinets | 47 | 32% |
| Telescope and objects related to space studies | 19 | 13% |
| Computer | 11 | 7% |
| Book | 7 | 5% |
| Animal | 5 | 3% |
| Formula, equation | 4 | 3% |
| Others (poster, plate, reward, cup, desk lamp, sphere, clock, etc.) | 12 | 8 |

of the scientist was refreshing; he was depicted as well-groomed and youthful, as shown in Fig. 12.

Like stereotypical objects found in scientists' drawings, fashion models' drawings also included more common things in their surroundings. As seen in Table 6, many students (32%) drew the model on a podium. Stage lights, cameras, audience, microphones, stage curtains, makeup desks with makeup utilities, changing rooms, and flowers were other commonly used objects in fashion models' surroundings. Figures 13 and 14 are examples of the model's working environment with stereotypical objects.

The findings indicate a prevailing inclination among students to depict scientists as solitary workers. As illustrated in Fig. 15, 92% of students envisioned a scientist laboring in solitude, while a mere 4% presented them as part of a collaborative team.

A further 4% of the drawings were categorized as ambiguous, primarily showcasing only the faces of the scientists. Students who depicted scientists within a group typically set the scene within a laboratory filled with space-related paraphernalia reminiscent of facilities akin to NASA, as highlighted in Fig. 16. Notably, as demonstrated in Fig. 17, a singular student portrayed a bustling laboratory with multiple scientists collaborating closely.

Some students depicted scientists working alongside a robot they had created, rather than with a human colleague, suggesting that they associate scientific work with advanced technology and innovation rather than traditional human collaboration.

### 4.4 Students' Perceptions and Knowledge of Diverse Scientists Based on Selections from a Table

Students were presented with a table featuring images of 40 scientists. They marked known or presumed scientists with a check (✓) and those unrecognized or not believed to be scientists with a cross (X). Table 7 reveals distinct trends: the top 12 most

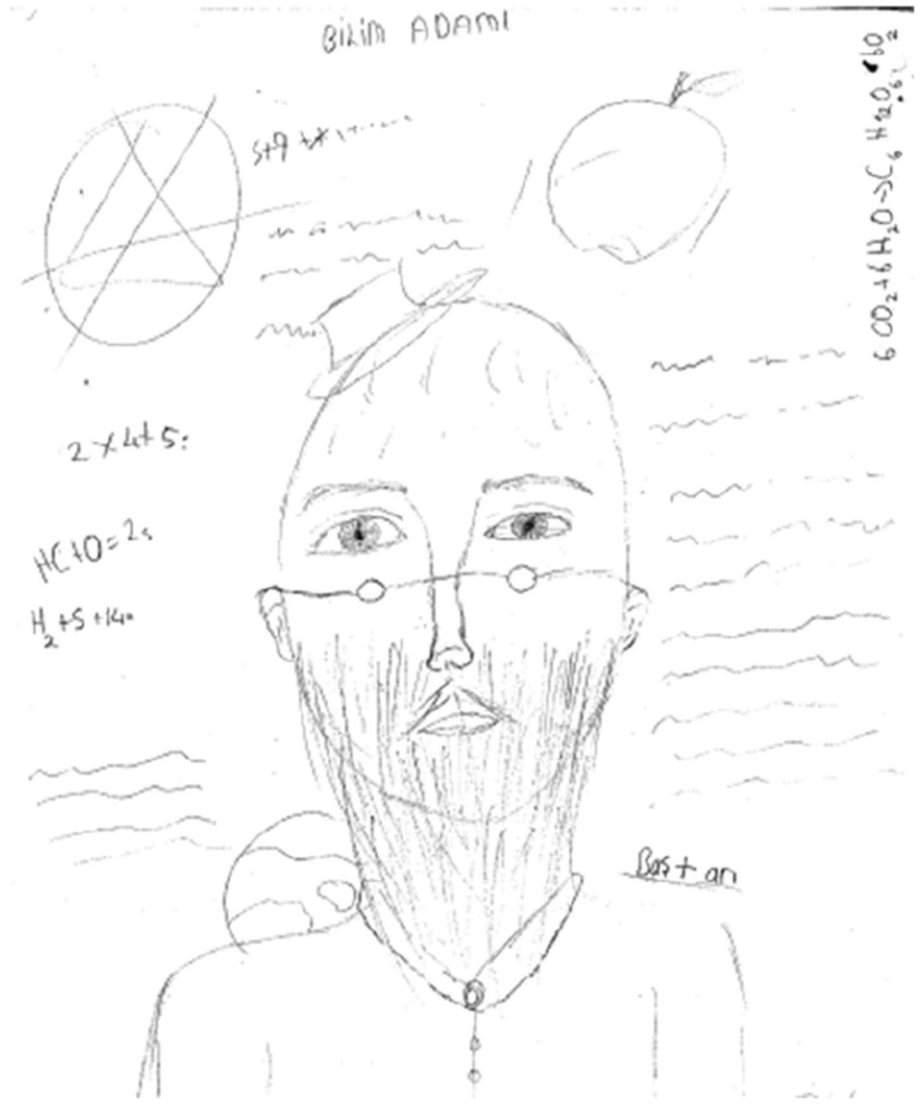


**Fig. 10** S089

recognized were male scientists, including historical figures like Albert Einstein, and contemporary ones such as Aziz Sancar, a Nobel laureate and nationally popular figure.

Intriguingly, the seven least recognized scientists were all female, including Marie Curie and current NASA professionals Betül Kaçar and Tiera Fletcher. These women were generally depicted without glasses and not in formal attire. Male scientists least frequently identified, such as Andrew Z. Fire and Shinya Yamanaka, tended to appear younger in their portraits, and some did not present Western characteristics.

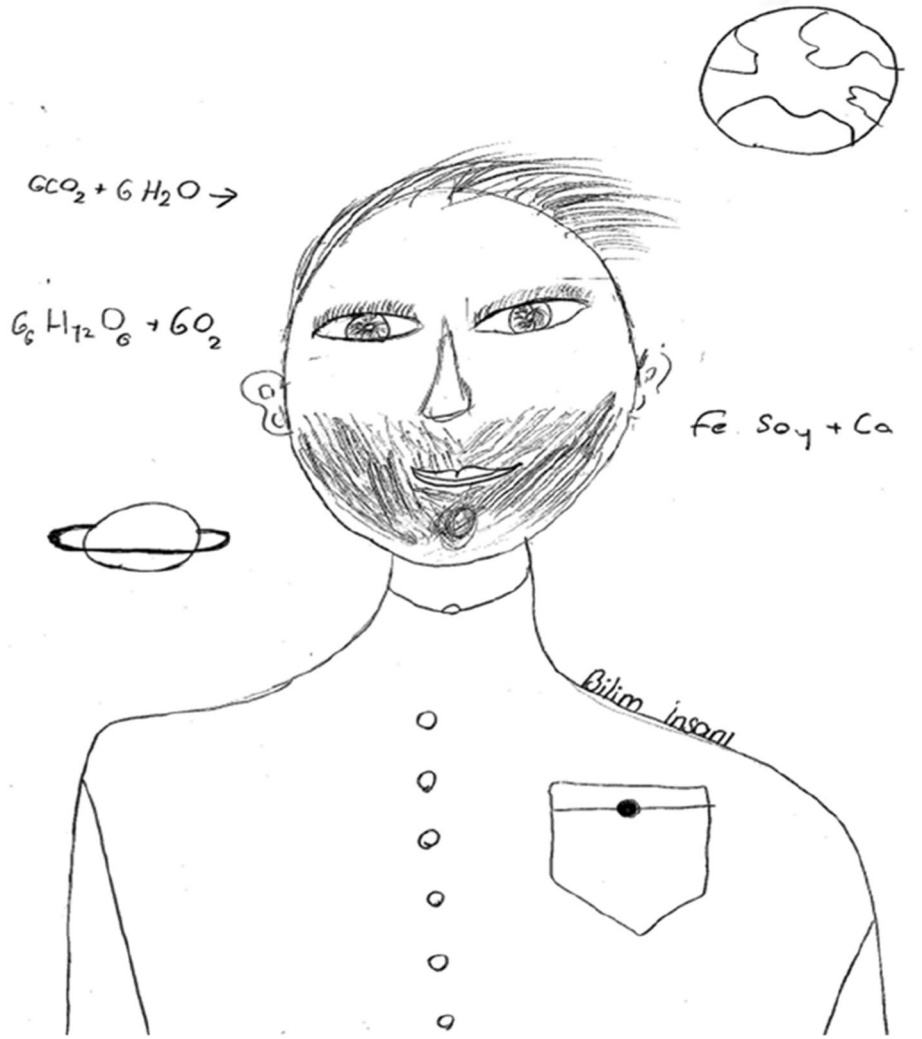


**Fig. 11** S098

## 5 Discussion

In our research, middle school girls primarily depicted scientists as men working alone indoors, such as in a laboratory, which echoes the findings of prior studies (El Takach & Yacoubian, 2020; Fung, 2002; Ivgin et al., 2021; Meyer et al., 2019). The contrast becomes stark when comparing these images to their representations of fashion models—who they often imagined to be married to scientists. The scientists were frequently drawn as men engrossed in their work within a lab, displaying little concern for their appearance. Conversely, the fashion models were illustrated focusing on their beauty and physical form. Notably, only 3% of the students sketched female scientists alongside male fashion models, and a mere 5% depicted female scientists and fashion models.


**Fig. 12** S149

**Table 6** Objects in the working environment of the fashion model as depicted in students' drawings

| Features in the environment | Frequency (*f*) | Percentage (%) |
|---|---|---|
| Podium | 47 | 31.97% |
| Stage lights | 17 | 11.56% |
| Camera | 17 | 11.56% |
| Audience | 17 | 11.56% |
| Microphone | 8 | 5.44% |
| Stage curtain | 7 | 4.76% |
| Makeup desk | 6 | 4.08% |
| Changing room | 6 | 4.08% |
| Flower | 5 | 3.40% |

Although not identifiable in their drawings, in their narratives, they mostly referred to perceived beauty (scientist being ugly and fashion model being beautiful) or perceived intelligence (scientist being brilliant and fashion model being not bright). This dichotomy reflects the deeply ingrained societal belief that men are suited for intellectual and high-status roles, while women are valued for their physical attributes and social roles. These representations echo broader cultural norms that define acceptable roles and behaviors for men and women, reinforcing the gendered division of labor and perpetuating systemic biases in career aspirations and opportunities (Eagly et al., 2000; Ridgeway & Correll, 2004).

The visual representations in the students' drawings echo these entrenched stereotypes. Scientists were frequently illustrated with Caucasian features, messy hair, and lab coats, a depiction that has remained essentially unchanged for decades (Chambers, 1983; Finson, 2002). Such portrayals indicate the cultural narrative that has historically equated scientific prowess with specific racial and gendered attributes (Ferguson & Lezotte, 2020). Although we did not identify any symbol of danger or secrecy in their drawings as listed as one of the stereotypes by Finson et al. (1995), their narratives

**Fig. 13** S145

demonstrated that they frequently referred to scientists doing hazardous experiments, and therefore, his spouse was concerned about having a child as a child potentially pursue his dad's profession.

It is paramount to contextualize the study within the broader literature on gender stereotypes in STEM fields. The findings revealing a predominant portrayal of scientists as male and fashion models as female by middle school girls resonate with the historical narratives of gender roles within science and society (Eccles et al., 1990). This dichotomy aligns with the social role theory, which postulates that societal expectations and cultural norms shape gender-specific roles, often associating women with communal roles and men with agentic domains (Eagly & Wood, 2012). This stark contrast mirrors the findings of previous research from Turkish culture as Basfirinci and colleagues (2019) also found that occupations including academician, surgeon, bank employee, etc. are perceived as masculine, except for positions related to nurturance such as nursing, which is viewed as feminine.

**Fig. 14** S41

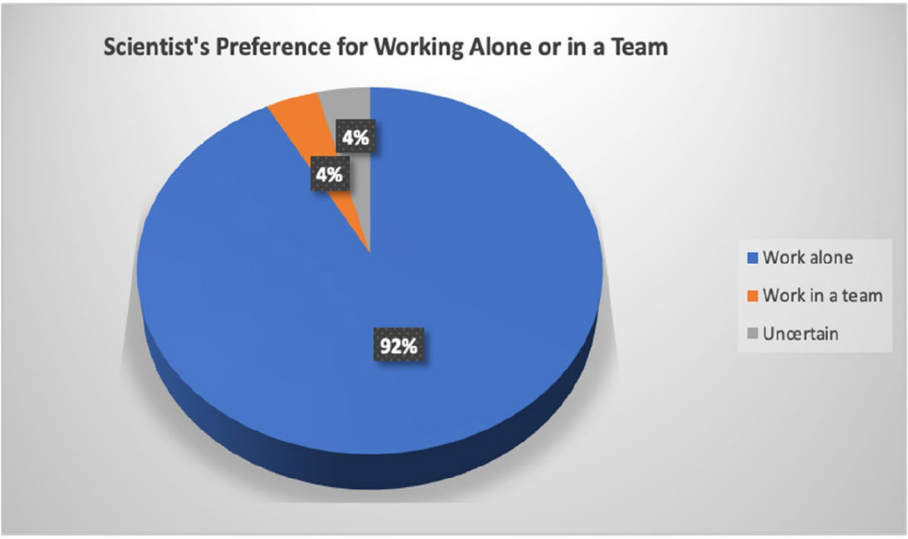


**Fig. 15** Preference of scientists: working team or in teams

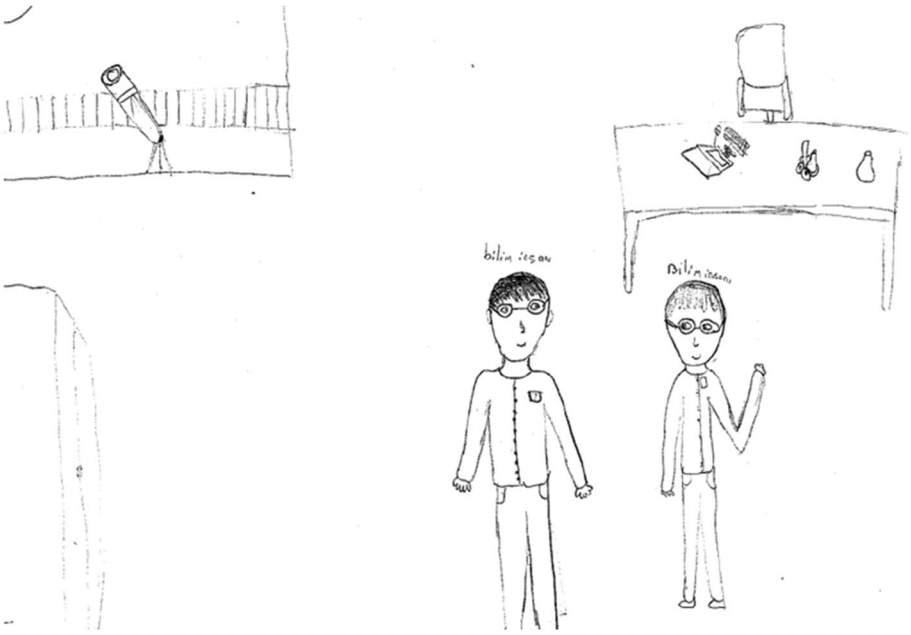


**Fig. 16** S080

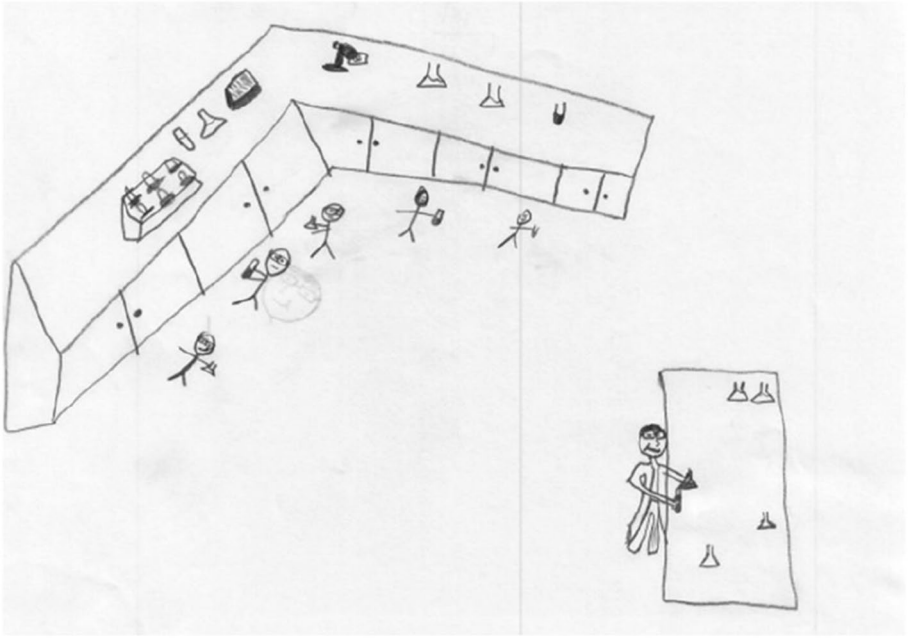

**Fig. 17** S063

**Table 7** Scientist selection table

| Scientists | Frequency and percentage | |
|---|---|---|
| | ✓ | X |
| 1. Albert Einstein | 142 | 7 |
| 2. Aziz Sancar | 109 | 40 |
| 3. Galileo Galilei | 108 | 41 |
| 4. Charles Darwin | 105 | 44 |
| 5. Benjamin Franklin | 104 | 45 |
| 6. Isaac Newton | 100 | 49 |
| 7. Archimedes | 99 | 50 |
| 8. Gregor Mendel | 88 | 61 |
| 9. Louis Pasteur | 85 | 64 |
| 10. Thomas Alva Edison | 83 | 66 |
| 11. Nicolaus Copernicus | 77 | 72 |
| 12. Michael Faraday | 77 | 72 |
| 13. Barbara McClintock | 76 | 73 |
| 14. Dimitri Mendeleyev | 69 | 80 |
| 15. Otto Hahn | 68 | 81 |
| 16. Elizabeth Blackwell | 67 | 82 |
| 17. Mae C. Jemison | 66 | 83 |
| 18. Nikola Tesla | 65 | 84 |
| 19. Niels Bohr | 63 | 86 |
| 20. Flossie Wong Staal | 60 | 89 |
| 21. Era Bogdanovsk | 60 | 89 |
| 22. Gertrude B. Elion | 58 | 91 |
| 23. Elizabeth Blackburn | 52 | 97 |
| 24. 2Seiji Ogawa | 54 | 95 |
| 25. Shinya Yamanaka | 46 | 103 |
| 26. Grace Hopper | 46 | 101 |
| 27. Jack Szostak | 45 | 104 |
| 28. Henrietta Swan Leavitt | 44 | 105 |
| 29. Feryal Özel | 37 | 112 |
| 30. Sau Lan Wu | 36 | 113 |
| 31. Stephanie Kwolek | 35 | 114 |
| 32. Özlem Türeci | 35 | 114 |
| 33. Andrew Z. Fire | 33 | 116 |
| 34. Marie Curie | 30 | 119 |
| 35. Jane Goodall | 26 | 123 |
| 36. Janaki Ammal | 25 | 124 |
| 37. Rosalind Franklin | 24 | 125 |
| 38. Betül Kaçar | 23 | 126 |
| 39. Tiera Fletcher | 23 | 126 |
| 40. Lise Meitner | 19 | 130 |

The persistence of these stereotypes is further exemplified in students' reasons for characters' decisions about parenthood. Students perceived fashion models as concerned with physical appearance post-childbirth, reinforcing traditional feminine norms and the societal valuation of women's physical appearance (Steinke, 2005). In contrast, scientists' careers were viewed as all-consuming, leaving little room for family life, a perception that aligns with past findings on the masculine image of science professions (Miller et al., 2018). Additionally, the students' narratives frequently highlighted the heightened responsibility of parenthood as a significant concern for the fashion model. This mirrors previous research showing that women are often expected to prioritize familial roles over career aspirations, contributing to the "motherhood penalty" that limits their career advancement. This is consistent with the observations of Miski Aydin et al. (2023), who noted that working mothers in Turkey often shoulder the primary responsibility for childcare, leading to increased family-work conflict and stress. In contrast, scientists' reluctance to have children was attributed to the demanding nature of their work, a reflection of the expectation that men prioritize professional achievement over familial responsibilities. These findings align with social role theory's assertion that the division of labor, influenced by cultural norms and biological differences, reinforces gender stereotypes (Eagly & Wood, 2012).

Interestingly, the narratives revealed a nuanced view of intelligence and beauty, where scientists were associated with intellect but not attractiveness and fashion models with beauty but not intelligence. This dichotomy starkly represents societal gendered expectations, pigeoning individuals into roles based on perceived aptitudes (Dasgupta & Stout, 2014). Such perceptions align with the findings of Sakallı-Uğurlu et al. (2018), who explored how Turkish undergraduate students describe women and men. Their study found that women were most associated with traits such as being emotional, sensitive, self-sacrificing, easily offended, and beautiful, whereas men were often described as strong, angry, rational, and ambitious. These gendered descriptions reinforce the societal stereotypes that limit individuals' potential by confining them to roles deemed appropriate for their gender, underscoring the deep-rooted nature of these biases in shaping both professional and personal identities.

The solitary depiction of scientists in the students' illustrations is a significant observation, indicating that despite changes in scientific workplaces towards more collaborative environments, the image of the lone scientist persists (Buck et al., 2002). This isolated figure of the scientist might also reflect societal perceptions of intellectual endeavors as solitary pursuits, further distancing the image of the scientist from communal or nurturing roles, which are often ascribed to women (Croft et al., 2015). However, it is essential to consider the impact of our study's prompt, where students were asked to depict a scientist and a fashion model who was married. This specific prompt, combined with the sequence in which students first wrote narratives and then drew the scientist and fashion model, may have influenced the tendency to illustrate only one scientist. Reinisch et al. (2017) highlighted a similar issue, noting that the prompt "Draw a scientist" is often taken literally by participants, potentially leading them to depict only one scientist, even if their actual conception includes more collaborative or team-oriented scientific work. They suggested that this limitation could be addressed by modifying the prompt to allow participants the option to draw more than one scientist. In our study, the prompt might have similarly guided students towards focusing on a single figure, possibly due to time constraints, self-perceived drawing skills, or the structured nature of the task, where the focus was split between two characters—a scientist and a fashion model. This could explain why most students depicted only one scientist, despite the changing realities of scientific work environments.

The impact of the COVID-19 pandemic, as evidenced by the inclusion of masks in some illustrations, showcases how contemporary events can influence students' perceptions of professional roles. This reflects the adaptability of societal perceptions in response to global events yet underscores how deeply seated stereotypes endure even amidst changing circumstances. Educational curricula should adapt to these changes by featuring diverse scientific careers that have gained prominence during the pandemic and by highlighting the immediate relevance of scientific work in addressing global crises.

Finally, students were more likely to recognize and select male scientists from the provided table and less likely to identify female scientists. The lack of recognition for female scientists, including well-known figures like Marie Curie and current professionals such as Betül Kaçar and Tiera Fletcher, highlights the ongoing invisibility of women in science. Studies have shown that even highly accomplished female scientists receive less media coverage and public acknowledgment compared to their male peers, perpetuating the stereotype that scientific success is predominantly a male domain (Cheryan et al., 2017; Steinke, 2005). This observation aligns with past research indicating that recognition of female scientists is often less than that of their male counterparts, which can affect the career aspirations of young girls (Bian et al., 2017; Nosek et al., 2002).

In conclusion, the findings of this study, when placed within the context of existing research, highlight the durability of gender stereotypes in shaping young girls' perceptions of scientists and other occupations, such as fashion models focused on this research. It underscores the need for continued efforts to dismantle these stereotypes through education, diverse representation, and cultural change within STEM fields.

### 5.1 Conclusion and Implications

The persistence of gender stereotypes not only affects individual choices but can also have a broader societal impact by influencing the diversity of the scientific community. This lack of diversity could lead to a homogenized perspective in scientific research and innovation, stifling creativity and the comprehensive understanding of complex issues that benefit from many viewpoints.

The implications of these findings are multifaceted. They call for re-examining how science is taught and portrayed in educational settings, encouraging a shift from traditional and stereotypical representations to more inclusive and varied ones. Educational curricula need to be designed to feature scientists from diverse genders and backgrounds, showcasing a realistic spectrum of who can be a scientist, highlighting women's contributions, the diversity of scientific settings, and the significance of teamwork in scientific endeavors (Yontar Toğrol, 2013). Additionally, this highlights the importance of role models and mentorship programs that connect young girls with female scientists, allowing them to visualize a place for themselves in STEM fields (Buck et al., 2002). While this study provides valuable insights into female students' perceptions of scientists and gender roles, the findings are specific to this demographic and may not fully apply to all students. Further studies that include male students are necessary to ensure that these recommendations address the needs and perceptions of all learners.

In conclusion, the study serves as a call to action for all stakeholders in education and STEM to work together to create a more diverse, inclusive, and equitable environment. The onus is on society to challenge and change the narrative around gender roles in science, thereby enabling a future where a scientist's potential is not pre-determined by their gender but by their passion, talent, and dedication to the field.

### 5.2 Limitations and Opportunities for Further Research

The study focused exclusively on middle school girls in a specific region of Turkiye, limiting the generalizability of the findings. Future research could include a more diverse demographic, encompassing various age groups, genders, and cultural backgrounds. The study primarily investigated stereotypes related to gender and profession. Other dimensions of identity, such as ethnicity, socio-economic status, and regional backgrounds, were not deeply explored. The study provides a snapshot of perceptions at a specific time. Longitudinal studies could track how perceptions evolve, particularly with changing educational practices.

One limitation of this study is its geographical specificity, as data was collected from middle school students in a particular region of Turkey, which may limit the generalizability of the findings to other regions or cultures globally. It is essential to interpret the findings within the specific cultural and geographical context in which the study was conducted, as local norms and values likely influenced the participants' perceptions. Future research would explore similar themes in different cultural contexts and deepen the understanding of how societal norms influence global perceptions of scientists and other professions. Implementing a longitudinal study design would offer insights into how perceptions change as students mature and are exposed to different educational and societal influences. Research could focus on the effectiveness of various intervention strategies in altering these perceptions, such as mentorship programs, gender-neutral educational resources, and media literacy programs. With the increasing influence of digital media, investigating the role of online platforms and social media in shaping young students' perceptions would be a fruitful study area.

Considering the potential impact of gender on students' stereotypes and perceptions, it is important to recognize that gender plays a significant role in how individuals internalize and reproduce societal stereotypes, particularly regarding professions such as science and modeling. Male students, for instance, might perceive and depict these roles differently due to varying socialization experiences, cultural expectations, and exposure to gender norms. For example, while female students might emphasize appearance and nurturing roles when depicting fashion models, male students could focus on different attributes or portray scientists with different characteristics, reflecting alternative cultural expectations or personal experiences.

This study, however, focused exclusively on female students, which precludes a direct comparison with male perspectives. As a result, the findings may not fully capture the range of stereotypes present among all students. To provide a more comprehensive understanding of how gender influences students' perceptions of scientists and fashion models, future research should include male participants. Such studies could offer valuable insights by comparing representations across genders, highlighting whether and how gender-specific stereotypes manifest differently and the extent to which these differences are shaped by cultural and societal norms.

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## Declarations

**Conflict of Interest** The authors declare that they have no conflict of interest.

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