Teachers' Implicit and Explicit Gender Stereotypes: Perceptions of Mathematics Achievement

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Article Info

Abstract

This study examined Lebanese primary school teachers' gendered perceptions of mathematics ability using a mixed-methods survey. The research explored both explicit and implicit beliefs, drawing on gender schema theory and implicit bias theory. A total of 204 private school teachers took part. In the first part, teachers were randomly assigned to evaluate a student vignette describing identical moderate mathematics performance, with either a male, female, or gender-neutral name. No statistically significant differences were found across gender conditions for current or future achievement ratings. An adapted Implicit Association Test (IAT) measured teachers' unconscious associations between gender and academic subjects. The IAT produced no significant gender-subject associations at the group level. Interaction effects involving teacher gender, age, and education suggested that implicit beliefs may vary across subgroups, warranting further investigation. Teachers' explicit gender beliefs were assessed using a teacher gender stereotype scale. Multivariate analyses found that male and older teachers were more likely to agree with stereotypical statements about mathematics and gender. Although teachers' direct evaluations were not gendered, beliefs about gender and mathematics were still present among certain groups. Future studies could examine if similar findings appear in Lebanese public schools or other subject areas and explore how teacher training might reduce the persistence of subtle gendered beliefs.

Introduction

Academic subjects are often viewed through a gendered lens, with mathematics commonly positioned as a male domain and areas such as languages or arts as feminine (Archer, L., 2005; Elwood, 2010). Subject gendering draws on gender essentialist beliefs, assuming natural differences in cognitive ability and interests between boys and girls (Gelman, 2003; Paule, 2015). In turn, these assumptions influence students' self-perceptions and teachers' expectations (Beiock et al., 2010; Doyle & Voyer, 2016). In Lebanon, teachers continue to view mathematics as a male-oriented subject, with boys' success attributed to talent and girls' to diligence (Sarouphim & Chartouny, 2017).

Teachers' Biased Mathematics Evaluation and Success Attribution

Research shows that teachers' assessments can reflect gender bias. For instance, Heyder et al. (2019) found that girls received lower evaluations than boys for identical achievement, and Copur-Gencturk et al. (2020) noted that teachers rated girls lower in mathematical ability despite equal accuracy. Similar patterns have been observed in studies across Europe and North America (Holder & Kessels, 2017; Mizala et al., 2015; Riley, 2014), often linking boys' success to ability and girls' to effort.Earlier research (e.g., Swim & Sanna, 1996) and more recent studies (Espinoza et al., 2014; Hand et al., 2017; Holder & Kessels, 2017) consistently show that teachers attribute boys' success in mathematics to ability and girls' lack of success to limited aptitude. In Germany, Tiedemann (2000) found that boys' failure was explained as a lack of effort, whereas girls' failure was seen as inability. Similar findings were reported by Fennema et al. (1990) in the United States. Hand et al. (2017) noted that American teachers rated boys as having greater mathematical talent than girls.

In Germany, Holder and Kessels (2017) found that boys were consistently rated higher in mathematics by teachers, despite equivalent standardised test scores. In another study from the United States, Espinoza et al. (2014) reported that teachers initially judged boys' success as ability-based and girls' success as effort-based; exposure to literature on growth mindsets reduced this bias temporarily. One of the few qualitative studies, by Riley (2014) in Western Canada, found that teachers credited girls' mathematics success to hard work and maturity; on the other hand, boys' underachievement was attributed to systemic factors. The consistency of these findings across contexts indicates that gendered attribution patterns are widespread.

Most research has taken place in Europe and North America, reflecting academic interest and available funding. However, little work has examined the reasons behind such bias or the factors influencing teachers' gendered judgements. This remains an important gap. Many of these studies have used experimental designs (Heyder et al., 2019; Holder & Kessels, 2017; Mizala et al., 2015), which allow for detecting subtle bias (Atzmüller & Steiner, 2010). These have typically focused on explicit responses. To explore unconscious stereotypes more thoroughly, the Implicit Association Test (IAT) has been proposed (Greenwald & Banaji, 1995), yet very limited research has applied this tool in relation to teachers and mathematics. Jackson et al. (2014) used a paper-based IAT (Nosek & Banaji, 2001) with United States STEM faculty to assess gender bias before and after diversity training. Jackson et al. (2014) found that brief diversity training improved male faculty's implicit attitudes toward women in STEM,

while Nosek and Banaji (2001) validated the use of IAT and GNAT to detect implicit gender–science biases not captured by explicit measures.

Passolunghi et al. (2014) used IAT with students in Italy and found that both implicit and explicit stereotypes associated mathematics more strongly with males. Smyth and Nosek (2015) found that American women in science had weaker male-science associations than men. Only one study, a dissertation by Levin (2019), has used IAT with teachers. In Brazil, Levin's study reported that male teachers showed strong bias favouring boys, whereas female teachers did not. Levin also noted differences linked to teachers' education levels. The IAT is important to learn about unconscious associations when the influence of conscious response patterns is removed (Greenwald & Banaji, 1995). However, its use in studying teacher perceptions of gender and mathematics remains limited.

The Interrelatedness of Gender Bias in Stereotypes and Counter-Stereotypes

Experimental studies show that gender bias in education can take different forms. Some teachers rate girls more favourably in maths because they seem motivated or hardworking, not because they are seen as capable. This pattern, called gender-contrasting bias, still reflects the idea that maths is a male subject. Girls are often judged as diligent but not gifted, while boys are seen as talented but unmotivated (Brown & Stone, 2016; Falch & Naper, 2013). These views reinforce old ideas about gender and ability in ways that may not match actual performance.

Teachers' views on behaviour often reflect similar bias. Heyder and Kessels (2015) found that boys who acted out were seen as less engaged, but not less intelligent. Teachers may not see this behaviour as a sign of low ability, especially when it fits ideas about masculinity (Connell & Messerschmidt, 2005; Cornwell et al., 2013). Girls, on the other hand, were rated higher in maths when they behaved well, not because of their skills (Robinson-Cimpian et al., 2014). Over time, these beliefs may lower expectations for girls' ability, even if they do well. This issue has been studied mostly in the West, but different patterns may appear in Lebanon, where schools and teachers face different pressures.

The Lebanese Context

In Lebanon, approximately two-thirds of students attend private schools (CRDP, 2019), a phenomenon driven by longstanding perceptions of quality disparities between private and public education. Many private institutions are better resourced, offer instruction in foreign languages (particularly French or English), and maintain smaller class sizes (Bahou, 2015), making them more appealing to families across socioeconomic lines (Al Khalili, 2025). This dominance could create a divided system where private school teachers may hold different expectations or teaching approaches than their public counterparts. For instance, private schools often emphasise academic performance and parental involvement (Bahou, 2015), which might shape teacher beliefs about student potential differently than in public schools. If private institutions tend to promote meritocratic or performance-based models, this might moderate (or conceal) stereotypical evaluations, prompting them to align with institutional expectations and approaches.

Gender Stereotypes in Lebanese Education

Research on gender stereotypes within Lebanon's education system is limited but revealing. Sarouphim and Chartouny (2017) found that teachers in private middle schools held traditional beliefs, perceiving male students as more capable in mathematics than females. However, the study's small sample size limited the generalizability of its findings.El Takach and Yacoubian (2020) explored perceptions of scientists among middle school students and teachers, detecting a bias towards male scientists and a notable absence of female representation. This proposes that gender stereotypes may also shape how science is taught and perceived, not just mathematics. Hariz and Moukarzel (2019) examined perceptions of students' mathematics performance in single-sex and coeducational settings. Despite no significant gender differences in performance reported, teachers perceived boys as more focused, and female teachers were more tolerant of disruptive behaviour. The study did not critically assess these perceptions as potential gender biases.

Emphasis on Giftedness and Potential Gender Implications

Several studies have focused on the identification and support of gifted students in Lebanon (e.g., Antoun et al., 2020, 2023; Antoun & Plunkett, 2023; Sarouphim, 2009; Sarouphim & Maker, 2010; Sarouphim, 2015). They aimed to enhance educational outcomes for high-achieving students, but they often overlook the role of gender in perceptions of giftedness. El Khoury (2014) noted a tendency to identify boys as more gifted, raising concerns about potential gender bias in the identification process.The emphasis on innate talent in these studies may inadvertently reinforce gender stereotypes, mainly in subjects like mathematics, which are often associated with inherent ability. This focus may marginalise students who do not fit traditional notions of giftedness, including girls who may be perceived to excel through diligence and interest rather than innate talent.

The Current Study

Research on gender stereotypes in mathematics education in Lebanon remains scarce, mainly in mathematics and in studies that use experimental methods or examine teachers' implicit biases. Teachers' perceptions can shape students' attitudes toward mathematics. Negative beliefs can affect students' achievement and self-confidence. Research in such an area may help define factors affecting perception and help support efforts towards promoting gender equity in education. This study attempted to fill the existing gap by examining explicit and implicit gender biases among teachers in Lebanon.

Theoretical Background and Research Questions

The current project drew on two theoretical approaches to investigate teachers' gendered perceptions of mathematics ability: implicit bias theory (Greenwald et al., 2002) and gender schema theory (Bem, 1981).Implicit bias theory is grounded in the concept that individuals can hold unconscious beliefs and associations about social groups (Greenwald & Banaji, 1995; Greenwald et al., 1998). These biases operate unconsciously and can subtly influence behaviour and decision-making, regardless of whether we believe we act without prejudice. This study

used the Implicit Association Test (IAT) to explore automatic links between gender and academic domains. The IAT is widely used to reveal unconscious associations that participants may not report explicitly. Gender schema theory (Bem, 1981) provided an additional lens for understanding how cultural beliefs about gender are internalised. These, in turn, can influence individuals' expectations and behaviours. According to gender schema theory, people develop cognitive frameworks that guide how they interpret and respond to information about gender. These schemas can lead to the categorisation of activities, abilities, and careers as either "masculine" or "feminine" (Archer, J. & MacRae, 1991; Elwood, 2010), thereby influencing teachers' judgments of student abilities and potential. This study used an experimental vignette to test if teachers attributed the same student performance differently depending on gender. Teachers' Gender Stereotype Scale Towards Mathematics (Nurlu, 2017) was used to assess the extent to which teachers endorsed gendered beliefs about mathematics ability, career appropriateness, and attributions of success. It was necessary to explore gendered perceptions at a subconscious and conscious level to tackle a complex social phenomenon like gendered perceptions (Lorber & Farrell, 1991) and grasp it from different angles. Using self-reported measures alone or interviews would have captured conscious beliefs. However, it would have missed the unconscious biases that teachers themselves might not be aware of or might avoid expressing. A multi-method approach enhances validity by triangulating data from different sources, reducing the limitations of any single method. It also addresses a key gap in previous Lebanese and international research, where few studies have integrated explicit and implicit measures to explore teacher gender perceptions.

This study was guided by three main research questions:

1. How do teachers evaluate students' mathematical achievement, and to what extent do these evaluations reflect gendered perceptions?

2. What implicit associations do teachers hold between gender and academic subjects such as mathematics, arts, and literature?

3. How do teachers' beliefs about mathematics and gender vary across demographic characteristics such as age, education, and gender?

These questions informed the following hypotheses:

- *H1:* Teachers will evaluate students differently based on gender, rating boys more favourably than girls for equivalent mathematical performance.

- *H2*: Teachers will show implicit associations linking mathematics with males and arts/literature with females, as measured by the IAT.

- *H3:* Teachers' explicit gender beliefs about mathematics will vary by demographic characteristics, with some groups more likely to endorse gender-stereotypical views.

Methodology

Participants

A survey method targeted mathematics teachers aged 18 or older residing in Lebanon. Six middle schools, seven high schools, and 11 after-school learning centres offering mathematics learning support agreed to participate, and the electronic survey was distributed to their respective mathematics teachers. All the schools and learning

centres in the study followed a co-educational model, where female and male students were educated together. Notably, seven schools could not participate for reasons beyond the research team's control and specific to the individual school circumstances. These schools expressed challenges such as a lack of access to reliable Wi-Fi, electricity issues, teachers having tight schedules, or the need to prioritise school maintenance due to concerns related to cholera and COVID-19.

The sample comprised $N = 204$ mathematics teachers, and 36 of 204 participants chose to take the survey in Arabic rather than English. This suggested that most participants were proficient or comfortable in the English language. It is also possible that having the survey primarily designed and presented in English (with an Arabic drop-down selection) could have influenced their decision to choose English. The sample consisted of 204 teachers, the majority of whom identified as female (74.5%), which aligns with broader trends in Lebanon and globally, where women make up the majority of the primary education workforce (OECD, 2023; UNESCO, 2016). Most participants were in the 26–40 age range and held at least a bachelor's degree. Notably, only a small proportion reported having a formal teaching qualification, reflecting national data indicating that only 18.8% of educational staff in Lebanon hold an educational certificate (CRDP, 2020). Teachers represented a range of grade levels and school types, with nearly half teaching in private institutions. Most identified as Muslim (66.7%) or Christian (15.2%), and although religion was not a focus of this study, it was noted for descriptive purposes to reflect the diversity of the sample see Table 1 for full demographic details).

Table 1. Demographic Characteristics of the Sample

		n	**%**
Nationality			
	Lebanese	147	72.1
	Palestinian	33	16.2
	Syrian	7	3.4
	Lebanese Armenian	2	1.0
	Lebanese-other nationality	12	5.9
	Other	3	1.5
Grade Level			
	Kindergarten	31	15.2
	Primary 1, 2, 3	67	32.8
	Primary 4, 5, 6	54	26.5
	Intermediate 7, 8, 9	31	15.2
	Secondary 10, 11, 12	21	10.3
Type of School			
	Public	10	4.9
	Private	99	48.5
	Special education	53	26.0
	Free private/Private charity	42	20.6

$N = 204$

Instruments

The survey was designed, collected, and managed electronically using Qualtrics software. The entire survey was translated into Arabic by a professional translator experienced in educational and psychological research. To ensure accuracy and equivalence (Harkness et al., 2010), the translation underwent a back-translation process and was reviewed for cultural appropriateness. A pilot test with a small group of Lebanese teachers confirmed that the Arabic version was clear and consistent with the original English wording. As participants completed the survey in only one language, the data were analysed as a single dataset following standard practice for bilingual survey administration (Behling & Law, 2000). The survey comprised five parts: an introduction and consent, demographic questions, an experimental vignette, an IAT, and a teachers' gender stereotype scale toward mathematics.

Experimental Vignette

The participants were randomly assigned using Qualtrics' built-in randomiser to one of three student profiles: a boy (Samir), a girl (Lara), or a gender-neutral student (The Student). This approach was chosen to keep the number of participants as balanced as possible across the three groups (Nederhof, 1985; Rymes, 1996).The student description was based on typical expectations for Lebanese fourth-grade mathematics (CRDP, 2020). The student was presented with average skills: able to carry out basic operations like addition, subtraction, and multiplication, but showing clear difficulties with fractions, decimals, and problem solving. Moderate performance, rather than very high or very low achievement, was intentional. It was supposed to allow for a clearer test of potential bias in teacher judgment without skewing the results through extreme achievement levels. Using a standardised test level was not possible because no consistent national benchmark exists for evaluating mathematics proficiency in Lebanon at this stage of schooling (CRDP, 2017).Teachers were then asked to rate the student's current mathematics performance and their expected future performance, both on five-point scales (Fagerlin et al., 2007).

Implicit Association Test (IAT)

The IAT, developed by Greenwald et al. (1998), is widely used to measure implicit biases by capturing reaction times in sorting tasks. Traditionally delivered through platforms like Millisecond (Inquisit, 2016) and Gorilla (www.gorilla.sc), the IAT was adapted for this study using Qualtrics to avoid costs and technical barriers. This approach followed the validation work of Carpenter et al. (2019), who demonstrated the reliability of Qualtrics-based IATs. The survey integrated JavaScript and HTML to capture response times and incorporated demographic and vignette sections within a single link for easier remote participation. Materials and design templates were sourced from the Open Science Framework (http://osf.io/ntd97, see Figure 1 for the IAT set-up).

The IAT in this study assessed implicit associations between gender and academic domains (mathematics vs. arts). Participants were asked to rapidly sort stimuli (e.g., "algebra," "literature," "boy," "girl") into categories using keyboard keys ('E' and 'I') (see Figure 2 for a sample display). According to Greenwald et al. (1998, 2002), quicker associations suggest stronger mental connections. For example, hesitation in assigning "algebra" to the

"girl" category would indicate a weaker association.

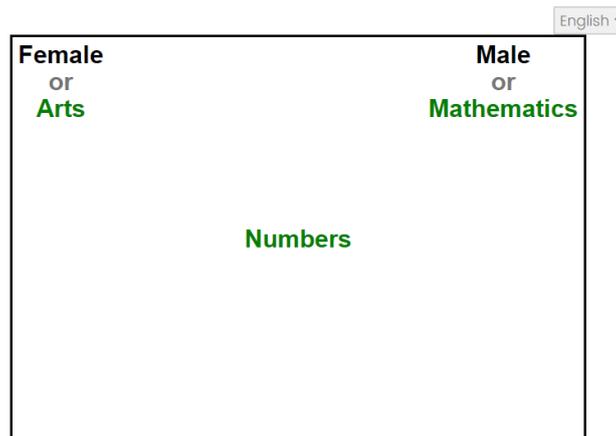Figure 1. IAT Set-Up for Gender and Mathematics and Arts Stimuli

Figure 2.A Sample IAT Displayed in the Survey

Qualtrics randomly assigned each participant to one of four test blocks, each containing seven trials (the first two serving as practice). Stimuli order and pairing were based on the model by Greenwald and Nosek (2001). An inter-stimulus gap of 250 milliseconds was applied, with errors flagged after 300 milliseconds and requiring correction.

To ensure standardisation, participants were instructed to use a computer with a physical keyboard. Recruitment material reinforced this instruction, and an automated device-detection feature prevented participants from using mobile devices (see Figure 3 for English translated instructions). The IAT was piloted with five teachers to test randomisation, functionality, and data recording across all blocks (see Figure 4 for survey flow).

Attention Teachers: You must use a computer/laptop with a keyboard to complete the survey.
In one of the tasks, you must place your left index finger on the key "**e**" and the right index finger on "**i**";
then, you need to sort the words that pop up on your screen as fast as possible.

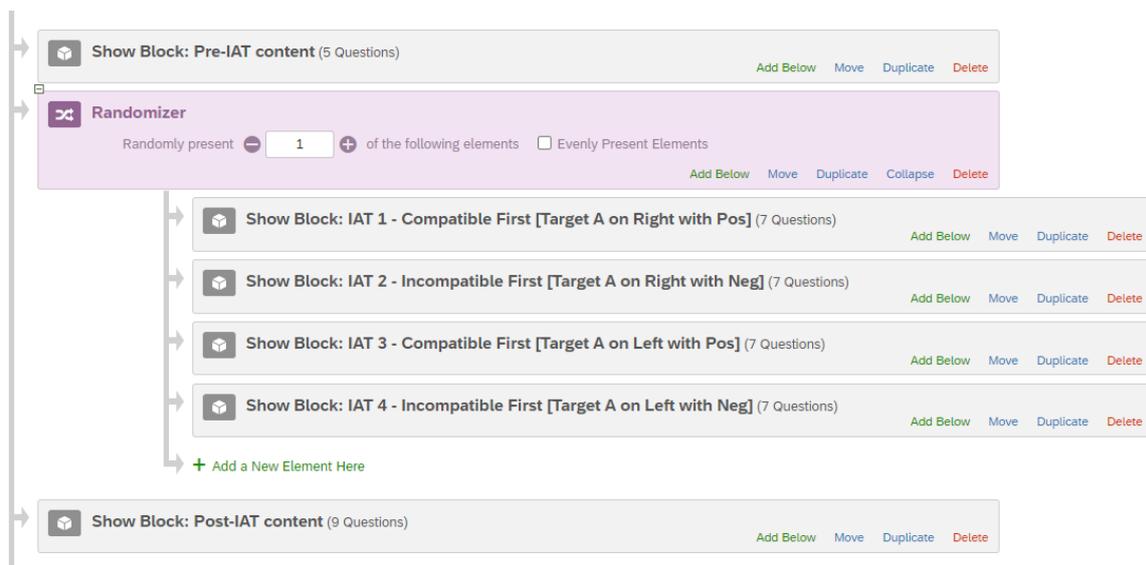Figure 3. Survey Email Content Notifying Teachers to Use a Computer with a Keyboard

Figure 4. IAT Survey Flow

Teachers' Gender Stereotype Scale Towards Mathematics

This was a 17-item scale developed by Nurlu (2017), initially as a two-scale-item: a Boy's scale, where the item's statement, for instance, would start with "Boys are more interested in,…" and a Girl's scale, as in "Girls are more interested in…". Nurlu (2017) formulated the items based on the literature (Keller, 2001; Leder & Forgasz, 2002; Räty et al., 2002; Tiedemann, 2000; Yee & Eccles, 1988) and ran the scale through exploratory and confirmatory factor analysis. The scale items were categorised into four factors: Environment (e.g., Leder & Forgasz, 2002); Gender Appropriateness of Careers (e.g., Correll, 2001); Competence (e.g., Tiedemann, 2000); and Attribution of Success (e.g., Brookhart, 1997). These factors examined teachers' agreement with how parents and peers perceived mathematics as a male domain, boys' preference for mathematics career choices, and the attribution

behind boys' mathematical success.

The Boy's scale was used in this study since its primary objective was to evaluate the extent of stereotypical beliefs concerning the masculinity of mathematics. The scale was adapted from a 5-point to a 7-point Likert ranging from 1) strongly disagree to 7) strongly agree; the higher the agreement, the more indication of being stereotypical. The scale demonstrated excellent internal consistency and reliability (Pavot et al., 1991) with a Cronbach's Alpha value of .97 in this study's sample. In a Turkish sample, Nurlu (2017) reported Cronbach Alpha values of .88 and .91 for the Boys' and Girls' forms, respectively, indicating adequate reliability. One representative item for each factor is shown in Table 2.

Table 2. Teachers' Gender Stereotype Scale Towards Mathematics: Boys' Form Factor

	Items
Environment	Compared to girls, boys are seen as more competent in mathematics by their parents.
Career	Boys are encouraged more than girls to choose a career in a mathematically related area.
Competence	Boys understand mathematical concepts more easily than girls do.
Attribution	Compared to girls, boys mostly increase their mathematical achievement because of the support of their teachers.

Data Collection Procedure

Given COVID-19 travel restrictions and the impracticality of returning to Lebanon for in-person data collection, a local research assistant was hired to support the process. Ethics approval was obtained from the author's affiliated institution. The assistant was recruited via a paid Facebook advertisement and selected through an interview based on prior research experience. After induction, the assistant signed an agreement outlining their responsibilities. Data collection took place in September 2022.The assistant's tasks included contacting schools, securing verbal and written consent from school leaders, distributing the survey link to teachers, and maintaining regular communication with the researcher. Data collection was conducted following ethical principles of fairness, respect, and voluntary participation (Oliver, 2010). The assistant ensured a balanced gender sample, avoided controversial discussions, obtained informed consent, and prevented duplicate responses.Due to the inability to secure Ministry of Education approval, data were collected solely from private schools and after-school learning centres. These may differ from public schools in teaching methods and resources (Bahou, 2015), so findings may not fully represent the national education system. Beirut, known for its demographic diversity (Mackey, 2006; Sbaiti, 2008), was selected as the research site to enhance representativeness. All participating schools were in Beirut, and data were gathered during the off-peak teaching period (June to November).

Data Analysis Strategy

The data analysis strategy was designed to match the type of data collected and the research questions being addressed. The dataset retained from Qualtrics had a 100% completion rate, with no partially completed responses.

Data were cleaned, variable names were organised, and all statistical analyses were conducted using SPSS.To test H1, two separate one-way ANOVAs were conducted to compare teachers' ratings of students' current and future mathematics achievement across the three vignette conditions (boy, girl, gender-neutral). This approach was chosen as the outcome variables were continuous, and the independent variable was categorical. Descriptive statistics (means and standard deviations) were first examined to provide an overview of group differences prior to conducting the ANOVAs.For H2, which explored implicit associations between gender and subject areas, IAT data were first cleaned, and D-scores were calculated following the standard scoring procedure (Greenwald et al., 2003). A one-sample t-test was then performed to test if teachers showed a statistically significant bias in associating mathematics with male versus female categories. Additionally, a factorial ANOVA was used to examine whether teacher demographic characteristics (e.g., gender, years of experience) were related to differences in IAT scores. This allowed the exploration of possible interaction effects without conducting multiple separate analyses.

For H3, which focused on teachers' explicit beliefs about gender and mathematics, the analysis began with a descriptive examination of individual item responses of the stereotype scale. A confirmatory factor analysis (CFA) was then conducted to test the measurement structure of the four theoretical dimensions of the gender stereotype scale (Environment, Career, Competence, and Attribution). A MANOVA was then performed to examine differences in gender-stereotypical beliefs across demographic groups. A separate ANOVA was run for the Attribution factor due to its conceptual distinction from the other dimensions. Post hoc tests were applied where appropriate to explore any specific group differences.The following section outlines the findings of the study's three research questions, beginning with how teachers evaluate student achievement.

Results

Teacher Evaluation of Student Achievement (H1)

Data were split according to the gender treatment group to which teachers were assigned (male, female, neutral), and the means and standard deviations for the rating questions were analysed (see Table 3). Although the initial intention was to maintain an equal distribution of participants across the treatment groups, it is worth noting that the final sample resulted in 61 teachers in the Lara treatment group, 72 teachers in the Samir treatment group, and 71 teachers in the control group (no gender). This variation could be due to potential factors such as participants opting to terminate the survey prematurely. The mean rating was generally low across all groups on the two rating questions, indicating a tendency to evaluate the student's present and predict future performance as relatively poor and noting that the mean rating for "future" achievement was generally higher than the mean rating for "current performance" across all gender groups. Based on the mean interpretation, there seemed to be no strong gender stereotypical pattern. The mean ratings for the female gender in both ratings were relatively lower compared to the other gender treatment groups. Lara was rated $M = 1.64$, $SD = .70$ and $M = 2.25$, $SD = 1.09$. Samir's group was rated $M = 1.69$, $SD = .71$ and $M = 2.37$, $SD = 1.20$. The genderless group, The Student, was rated $M = 1.66$, $SD = .63$ and $M = 2.37$, $SD = 1.20$.

Two separate one-way ANOVAs were conducted to test for statistical differences in the evaluation among the

gender groups. The one-way ANOVA for the "current" and "future" mathematics performance ratings did not violate the homogeneity of variance assumption with non-significant p-values of .076 and 1.979, respectively. There was no statistically significant difference at the $p < .05$ level in the "current performance" rating for the three groups, $F(2, 204) = .11$, $p = .897$. Similarly, there was no statistically significant difference at the $p < .05$ level in the rating of "future achievement" for the three groups, $F(2, 204) = .244$, $p = .783$, indicating that the hypothesis (H1) was rejected.

Table 3. Descriptive Statistics for the Experimental Vignette

Gender Treatment		n	Minimum	Maximum	M	SD
Lara	Current Performance	61	1	5	1.64	.71
	Future Performance	61	1	5	2.25	1.09
Samir	Current Performance	72	1	5	1.69	.71
	Future Performance	72	1	5	2.37	1.20
The student	Current Performance	71	1	4	1.66	.63
	Future Performance	71	1	4	2.37	1.20

Implicit Associations Between Gender and Subject Area (H2)

The data from the IAT were preliminarily analysed via the iatgen suit Shiny app (Carpenter et al., 2019). The internet application automatically cleaned the data per Greenwald et al.'s (2003) guidelines; participants with more than 10% of responses faster than 300 ms and over 10000 ms were deleted as these were potential outlier responses. Eleven of the initial ($N = 204$) participants who completed this study's IAT were dropped due to excessive speed. They were replaced with a missing value of -99 datum to maintain the same number of rows as the initial data. SPSS was informed that values of -99.0 were discrete missing values, so it could automatically exclude them when calculating the mean or performing any other statistical analysis. The dropped trial (faster than 300 ms) was .015% of trials. The error rate (incorrect trials) was .063%.

Based on De Houwer and D Bruycker's (2007) method, the IAT's reliability was satisfactory at α = .76. The D-score for each participant was calculated by detecting the within-subject differences between compatible (male and mathematics/female and arts and literature) with the incompatible (female and mathematics/male and arts and literature) blocks' mean and dividing it by their standard deviation. This procedure was carried out twice, once for the practice trials and once for the experimental trials. The score was then averaged, resulting in a final D-score for each participant.

The IATs from the entire sample ($N = 193$) produced a positively scored D-score, $M_{D-score} = .03$, $SD = .36$, $df = 192$, indicating a weak association or less automaticity in the intrinsic association between gender and subject categories. The t-test of $t = 1.24$, $p = 0.213$, 95% CI$_{D-score}$ [-0.01889, 0.08418] revealed a p-value that did not reach statistical significance (p > 0.05), indicating that the D-score was not statistically significantly different from zero in this sample. Cohen's d indicated a small effect size of $d = 0.089$, indicating a minimal practical significance of the association between gender and subject categories. The lack of statistical significance suggested that the

observed association of $M_{D\text{-}score}$ = .03 might be due to random variability rather than a systematic pattern. Although the initial IAT did not yield statistically significant associations, it was essential to test the strength and direction of the associations between participants' IAT scores and various teacher characteristics and identify any potential relations that might not have been captured in the initial analysis.

A factorial ANOVA, also known as UNIANOVA (a univariate general linear model), was conducted between the participants' IAT scores (dependent variable) and different categories of variables such as age group, gender, education level, place of origin, and religion (independent) to determine the main effect of each independent variable and its level of interaction with the intrinsic association score (D-score). However, the assumption (based on mean) of equal variance between groups was violated with Levene's test, resulting in a p-value < .001 (F(30, 86) = 22.87, p = < .001), suggesting significant differences in the error variance between the groups or the conditions of the factorial ANOVA. Following the school of thought that considers ANOVA quite robust to the violation of the equality of variance (Blanca Mena et al., 2017), the analysis of this test could still go ahead, especially when having a large sample. To overcome this limitation, the values for education level were recoded into new variables by combining *no qualification* and *High school* into a single level named *no-to-some education* and combining *Master's* and *Doctoral* into a single level named *Postgraduate*. The statistical analysis was repeated.

The test between-subject effects revealed that teachers' age*gender effects were statistically significant at p = .007, yielding an effect size of η_p^2 = .109, indicating that 10.9% of the variance in intrinsic association scores was explained by age*gender, F(2, 86) = 5.24, p = .007. Teachers' age*education effects were also statistically significant at p = .01, yielding an effect size of η_p^2 = .187, indicating that 18.7% of the variance in intrinsic association scores was explained by age*education, F(7, 86) = 2.83, p = .01. Teachers' gender*education effects were statistically significant at p = .013, yielding an effect size of η_p^2 = .070, indicating that 7% of the variance in intrinsic association scores was explained by gender*education, F(1, 86) = 6.43, p = .013. Teachers' age*gender*education effects were statistically significant at p = .012, yielding an effect size of η_p^2 = .071, indicating that 7.1% of the variance in intrinsic association scores was explained by age*gender*education, F(1, 86) = 6.59, p = .012.

A post hoc test was performed for all the independent variables, but it was excluded for education level due to groups having fewer than two cases and for gender because this variable was dichotomous. No statistically significant findings were found for age, religion, place of origin, and education level in the factorial ANOVA analysis (p > .05). The Tukey HSD's test reported p-values of .298, .937, .991, and .898, respectively, thus indicating that there was not enough evidence to conclude that there were statistically significant differences in the intrinsic association between the specific groups being compared within the interaction.

Provided that the ANOVA gave some information on potential gender differences in intrinsic association with mathematics and arts/language, it was decided to focus on this specific comparison of interest. Since gender was a categorical variable with two levels of defined groups (1 = female and 2 = male), the independent-sample t-test was an appropriate statistical test to examine if there were statistically significant differences in the mean scores

of the intrinsic association between the two groups. The test revealed no statistically significant differences in scores for females (M = -3.89, SD = 19.34) and males (M = -9.42, SD = 29.50; t (66.62) = 1.262 [from equal variance not assumed] p = .212, two-tailed). The magnitude of the difference in the means (mean difference = 5.53, 95% CI: -3.21 to 14.28) was minimal (Cohen's d = .247). These results rejected H2. The findings hint at patterns of implicit bias in certain demographic combinations. However, due to violations of variance assumptions and small subgroup sizes, these findings should be interpreted with caution and explored further in future studies with larger, stratified samples.

Teachers' Gender Stereotypes Toward Mathematics (H3)
Preliminary Descriptive Analysis

Mean scores for the scale items ranged from M = 2.94 to 4.15, with standard deviations (SD) between 1.38 and 1.75 (see Table 4). The highest means were for "Boys are encouraged more than girls to choose a career in a mathematically related area" (M = 4.15, SD = 1.52) and "Boys are more interested in careers which require mathematical ability than girls are" (M = 4.01, SD = 1.52), implying strong endorsement of career-related gender stereotypes. Lower means were found for Attribution items, including "Boys mostly increase their mathematical scores when the examination is too easy" (M = 2.94, SD = 1.49). These items were phrased such that higher agreement could be interpreted as attributing boys' success to external factors rather than ability, which might suggest lower endorsement of gender stereotypes. Although it might have been reasonable to reverse-score them to align directionally with the rest of the scale, the original scale author (Nurlu, 2017) did not advise doing so.

Table 4. Descriptive Statistics for Teacher Gender Stereotypes in Mathematics

	M	SD
En1	3.41	1.39
EN2	3.42	1.38
EN3	3.68	1.42
EN4	3.71	1.56
Car5	4.01	1.52
Car6	4.15	1.52
Car7	3.91	1.65
Car8	3.86	1.54
Comp9	3.43	1.45
Comp10	3.42	1.51
Comp11	3.56	1.58
Comp12	3.28	1.65
Comp13	3.29	1.70
Comp14	3.28	1.65
Attr15	3.03	1.59
Attr16	2.94	1.49
Attr17	3.08	1.75

Confirmatory Factor Analysis (CFA)

CFA was conducted using AMOS (Arbuckle, 2019) to assess the four-factor structure (Environment, Career, Competence, Attribution) from Nurlu (2017). Sample size (N = 204) met recommendations for CFA adequacy (Hair et al., 2019; Kline, 2011). Fit indices (see Table 5) followed standard thresholds (Awang, 2015; Cheung & Rensvold, 2002; Hoe, 2008).

Table 5. Fit Indices Recommended as Frequently Reported in Literature

	Index	Level of acceptance
Absolute fit	χ^2	p-value > .05
	RMSEA	< .08
Incremental fit	CFI	> .90
	TLI	> .90
	SRMR	< .08
Parsimonious fit	χ^2/df	< 5.0

The Environment model showed adequate fit: $\chi^2(1)$ = 1.53, p = .22; CFI = .99; RMSEA = .05; SRMR = .01. A covariance between e13 ("Boys seen as more competent by parents") and e14 ("Parents think mathematics is more important for boys") was added (MI = 4.17), reflecting the strong conceptual overlap between parental competence beliefs and valuing of mathematics (Eccles et al., 1990).

The Career model fit improved after covarying e3 ("Boys are more interested in math careers") and e4 ("Boys are encouraged to pursue math careers") (MI = 17.12), reflecting research showing reciprocal links between career interest and encouragement (Correll, 2001).For the Competence model, multiple covariances were added between indicators conceptually tied to self-efficacy, logical reasoning, and mathematical problem-solving (Bandura, 1977; Lachman et al., 2015). Factor loadings exceeded .70.The full four-construct model (Table 6) showed satisfactory fit: χ^2/ df = 2.34; RMSEA = .08; CFI = .96; SRMR = .04 (see Figure 5 for the CFA measurement model).

Table 6. CFA Model Fit Indicators for Separate Constructs

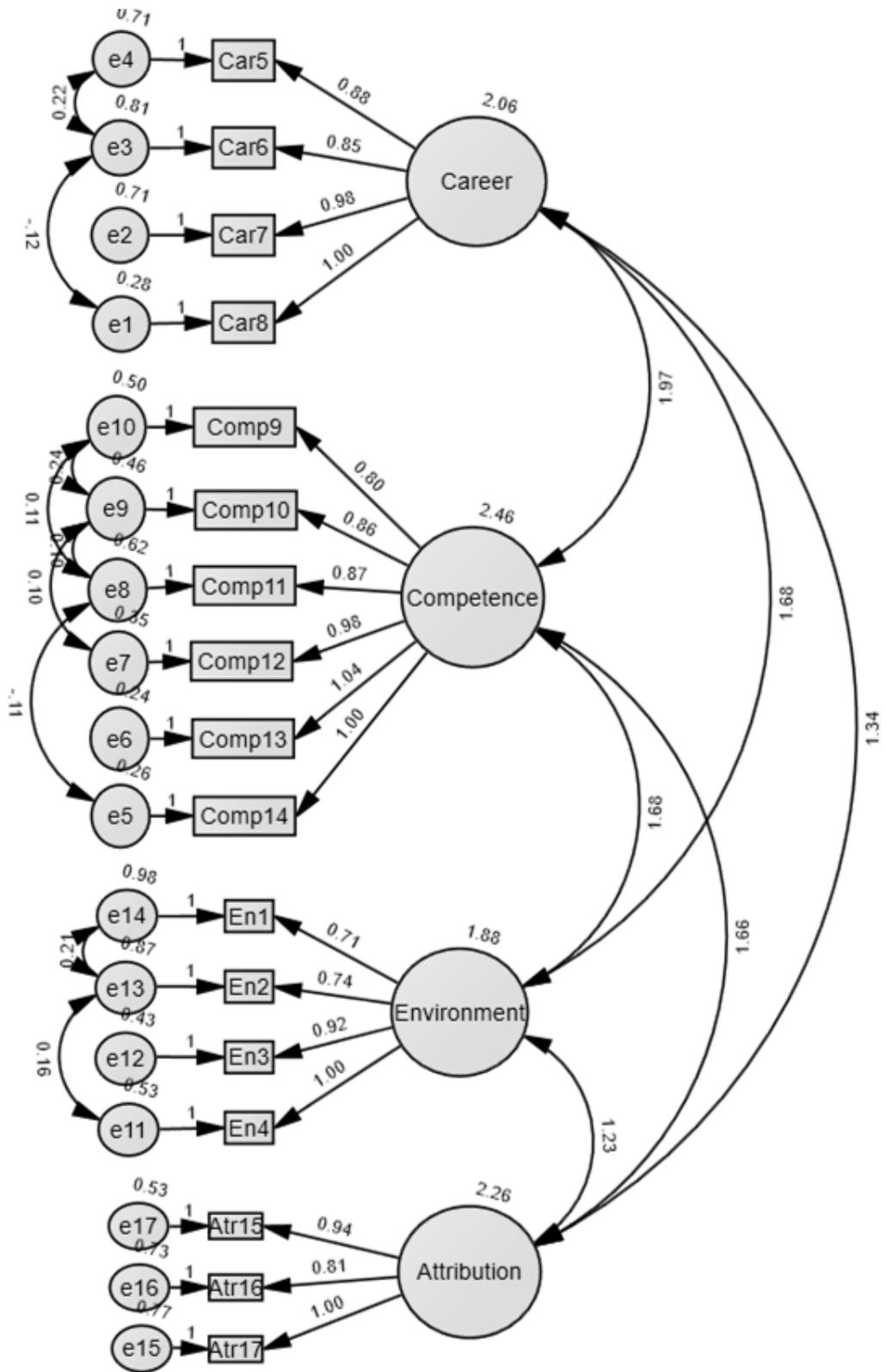| Model	χ^2	df	χ^2/df	CFI	GF1	RMSEA	TLI	SRMR
Environment	1.532	1	1.53	.99	.99	.05	.99	.01
Career	4.056	1	4.06	.99	.99	.12	.97	.02
Competence	10.221	5	2.04	.99	.98	.06	.99	.02
Attribution	23.591	12	1.97	.99	.97	.07	.98	.00
Four-Construct Model	243.78***	104	2.34	.97	.88	.08	.95	.04

**p < .01. ***p < .001.

Figure 5. CFA Measurement Model with Environment, Career, Competence, and Attribution Factors

Reliability and Validity

Construct reliability values exceeded .70 for all factors: Environment (.78), Career (.82), Competence (.92),

Attribution (.76). AVE values (see Table 7) supported convergent validity (Hair et al., 2019): Environment (.65), Career (.73), Competence (.83), Attribution (.73) HTMT ratios (Henseler et al., 2015) indicated good discriminant validity (< .90).

Table 7. Discriminant Validity of Constructs Evaluation Using HTMT Ratio

	Environment	Career	Competence	Attribution
Environment	**.67**			
Career	.83	**.74**		
Competence	.76	.86	**.85**	
Attribution	.58	.62	.70	**.73**

Monotrait correlations are bolded.

Normality assumptions were met with skewness < 1.0, kurtosis within −10 to +10 and critical ratios < 2.5. The Career model RMSEA remained slightly above conventional thresholds (.12 before modification). All adjustments were not based on statistical suggestions alone, but were also theory-driven and were necessary to achieve an acceptable overall model fit. For example, students who are encouraged to pursue mathematics-related careers are often those who already show interest in them, suggesting a two-way relationship (Correll, 2001). Other covariances were also reflected in links based on expectancy-value theory (Eccles & Wigfield, 2020) and research on gendered career aspirations (Eccles, 1983).

Group Differences in Gender Stereotype Beliefs: MANOVA and ANOVA Results

A one-way multivariate analysis of variance (MANOVA) was conducted to examine if teachers' beliefs towards mathematics showed a gender-stereotypical pattern, with potential differences in beliefs between teachers based on demographic characteristics (e.g., age, education, gender, place of origin). Composite variables were created for the four constructs: Environment, Career, Competence, and Attribution. This was done by averaging item scores within each factor, as recommended by Zimmerman et al. (2006). The Attribution construct was analysed separately using ANOVA, given its conceptual distinctiveness.For MANOVA, the first model included Environment, Career, and Competence as dependent variables. Box's M test indicated that the assumption of equality of variance-covariance matrices was tenable, $M = 35.93$, $F(30, 829.98) = 0.88$, $p = .657$ (Tabachnick & Fidell, 2013). Levene's test showed that homogeneity of variance was met for Environment, $F(30, 86) = 1.57$, $p = .064$, but not for Career, $F(30, 86) = 1.85$, $p = .015$, or Competence, $F(30, 86) = 2.19$, $p = .003$. Because homogeneity of variance was violated for two of the three dependent variables, Pillai's Trace was used for the multivariate test, following Tabachnick and Fidell's (2013).

The multivariate test indicated a statistically significant main effect for gender, $F(3, 84) = 4.52$, $p = .005$, Pillai's Trace $= .139$, $\eta^2 p = .139$. There was also a statistically significant combined effect of teacher gender and age, $F(6, 170) = 2.29$, $p = .037$, Pillai's Trace $= .150$, $\eta^2 p = .075$. This indicated that the combined effect of age and gender was associated with differences across the three dependent variables (Environment, Career, and Competence). Similarly, a significant multivariate interaction was found for age × origin × education level, $F(12, 258) = 1.92$, p

= .032, Pillai's Trace = .246, η^2p = .082.Follow-up univariate ANOVA on the MANOVA model revealed that male teachers reported significantly higher endorsement of gender stereotypes than female teachers across Environment (p < .001, η^2p = .133), Career (p = .005, η^2p = .087), and Competence (p = .003, η^2p = .096). Estimated marginal means showed that male teachers scored higher across all three domains: Environment M = 4.27, SD = 0.16; Career M = 4.74, SD = 0.19; and Competence M = 4.33, SD = 0.18. For females, the mean scores were Environment M = 3.92, SD = 0.11; Career M = 3.85, SD = 0.13; and Competence M = 3.80, SD = 0.13.A significant interaction effect between gender and age was found across all three dependent variables: Environment (p = .006, η^2p = .111), Career (p = .009, η^2p = .104), and Competence (p = .011, η^2p = .099). Mean scores showed that teachers aged 51+ agreed most with stereotypical statements: Environment M = 4.93, SD = 0.40; Career M = 5.00, SD = 0.48; Competence M = 3.79, SD = 0.46 (see Figure 6).
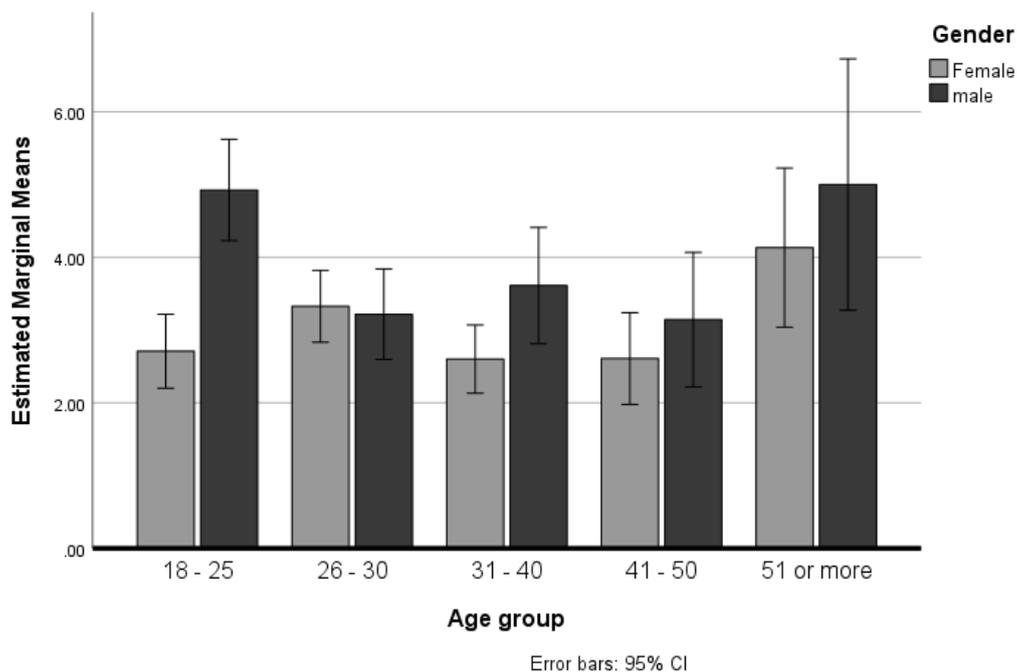

Figure 6. Estimated Marginal Means of Gender Across Age Groups

As mentioned, the Attribution construct differed conceptually from the other subscales; therefore, it was examined separately using a two-way ANOVA. Levene's test indicated non-equal variances, $F(30, 86)$ = 2.41, p < .001, so Pillai's Trace was again applied. Significant main effects were found for age, $F(4)$ = 2.97, p = .024, η^2p = .121, and gender, $F(1)$ = 4.79, p = .031, η^2p = .053. Interaction effects (see Table 8) were observed for age × gender (p = .002), gender × education (p = .010), and religion × education (p = .016).

Table 8. Main and Combined Effects of ANOVA Results

	df	*F*	*p*	$\eta_p{}^2$
Age	4	2.97	.024*	.121
Gender	1	4.79	.031*	.053
Religion	4	2.34	.061	.098
Education	3	1.81	.151	.059

	df	F	p	η_p^2
Origin	7	1.19	.315	.089
Age - Gender	2	6.62	.002**	.133
Age - Religion	6	.66	.684	.044
Age - Education	7	1.70	.120	.121
Age - Origin	13	1.17	.312	.151
Gender - Religion	1	1.67	.199	.019
Gender - Education	1	6.85	.010*	.074
Gender - Origin	2	.22	.802	.005
Religion - Education	3	3.64	.016*	.113
Religion - Origin	5	.69	.636	.038
Education - Origin	10	1.06	.401	.110
Age - Gender - Education	1	.95	.333	.011
Age - Gender - Origin	1	1.58	.212	.018
Age - Education - Origin	4	1.40	.241	.061

*$p < .05$. **$p < .01$.

Tukey's post hoc tests revealed that teachers aged 51+ scored significantly lower on Attribution than those aged 31–40 ($p = .009$, *Mdiff* = 1.67) and 41–50 ($p = .032$, *Mdiff* = 1.56). Female teachers across all age groups showed consistently lower Attribution scores than males (see Figure 7). Postgraduates also scored lower than teachers with high school diplomas, $p = .014$, *Mdiff* = -1.18. Although post hoc analyses for religion were mostly non-significant, a marginal difference was found between the "Other" and Christian groups, $p = .024$, *Mdiff* = 1.07. Among Islamic high-school teachers, the highest mean Attribution scores were reported (see Figure 8).
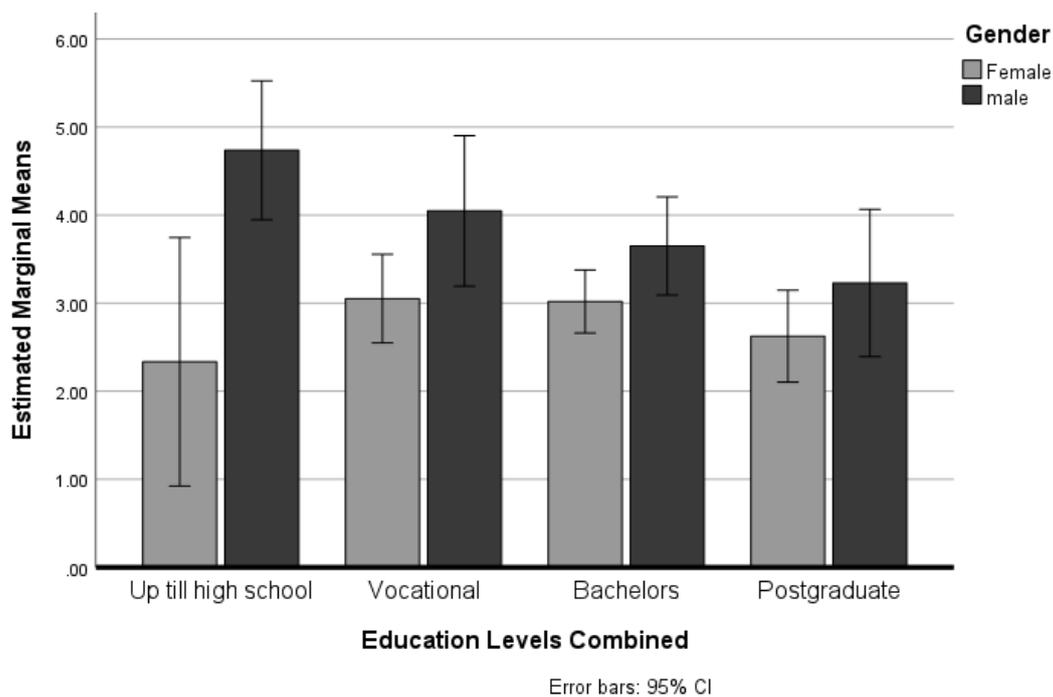

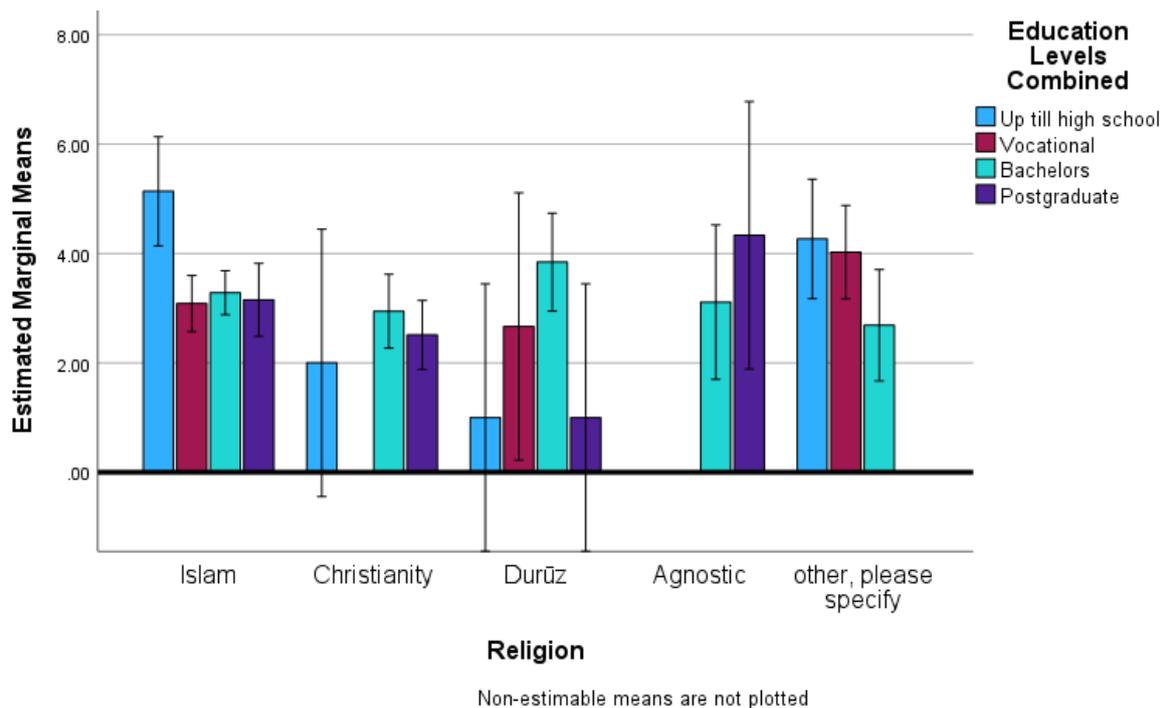Figure 7. Estimated Marginal Means of Gender Across Educational Levels

Figure 8. Estimated Marginal Means of Education Levels and Religion

Discussion

The results showed that Lebanese teachers did not significantly rate student performance differently across the gender conditions in the vignette experiment (H1 rejected). However, the IAT revealed some interactions between teacher characteristics and intrinsic/implicit associations, even though the overall *D*-score showed no significant bias at the group level (H2 rejected). The strongest findings were from the gender stereotype beliefs scale: male teachers, older teachers, and those with lower qualifications were more likely to endorse stereotypical beliefs about boys' competence, careers, and environment in mathematics (H3 supported). Female teachers and postgraduate-qualified teachers consistently reported fewer stereotypical beliefs. Interaction effects between teacher gender and age were also found, with older male teachers showing the greatest endorsement of stereotypes. Religion showed a slight and inconsistent effect, with small differences detected on the Environment and Attribution subscales. However, these results should be interpreted cautiously given the exploratory nature of this variable and potential uneven group sizes. As multiple statistical tests were conducted, these findings should be interpreted cautiously due to the potential risk of a Type I error.

Teachers' Evaluation of Mathematics Performance

The primary aim of this study was to examine if gender-based disparities existed in how teachers evaluated a fictitious student's mathematics performance (H1). The descriptive data indicated an inclination to perceive the student's present and future performance as relatively underwhelming for all gender groups. However, the mean rating for "future" achievement exceeded that of the present, suggesting a collective sense of optimism towards students' upcoming performance compared to their "current". The student profile presented a moderate level of

performance along with some issues in problem-solving, yet teachers collectively viewed it as relatively low. This could be due to various reasons, such as a high standard of excellence, a focus on evaluating the areas needing improvement, or even a cautious approach to avoiding overestimation. Overall, teachers' evaluations indicated a less lenient assessment of student performance. Furthermore, there was no detectable gender stereotypical pattern from the mean interpretation. There were no statistically significant differences across the three gender groups' "current" or "future" achievement ratings. These outcomes did not support the assertion of variance in how students were evaluated based on gender.

Several possible explanations exist for the absence of gender-based differences in teachers' evaluations. One possibility is that some teachers were aware of gender bias and aimed to evaluate students more fairly. It is also plausible that the sample's composition contributed to the equitable responses. For example, approximately 74% of participants held a university degree, which may reflect greater exposure to discussions about gender and education, indicating a growing awareness of gender fairness. The result may also be due to social desirability bias in self-report tasks (Nederhof, 1985).As mentioned earlier in the literature review, studies have found no gender differences in teachers' ratings of students' mathematics abilities (e.g., Lorenz et al., 2016); other research has provided evidence of bias (Bian et al., 2018; Espinoza et al., 2014; Nürnberger et al., 2016; Schober & Finsterwald, 2016).

In a mathematics assessment experiment controlling for gender and race variables, evidence indicated discrimination against female students; the assessment of vignettes revealed a preference for boys over girls in mathematics abilities (Copur-Gencturk et al., 2023). Girls were evaluated more negatively in mathematics, indicating bias in teachers' judgment due to gender stereotypes (Holder & Kessels, 2017). It is worth mentioning that the measures used in many experimental vignette studies investigating teachers' bias were often based on standardised testing and objective performance. Such methods might have allowed for a controlled and consistent evaluation. As mentioned, the researchers in the current study could not use a standardised mathematics achievement measure due to resource limitations. Future research must consider enhancements to create a more detailed vignette that reflects a more realistic classroom scenario to aid in capturing perceptions more authentically.

Unveiling Teacher's Intrinsic Association

A key objective of this study was to find whether there was an intrinsic connection between gender and subject categories in teachers' minds (H2). The analyses showed no statistical significance, leading to teachers' inherent association being attributed to random variability. However, follow-up analyses revealed some interaction effects between teacher characteristics, such as age, gender, and education, and their IAT scores. Although not uniformly strong, these interactions may reflect variability in implicit beliefs across demographic groups and suggest that bias is not monolithic within the sample. According to implicit bias theory (Greenwald & Banaji, 1995), unconscious associations may not be consistent across individuals but can reflect internalised social norms within specific groups, and bias mitigation strategies may need to be tailored to specific teacher subgroups rather than applied universally. The broader literature that used IAT showed that gender-subject stereotypic association is

evolving. As mentioned, the IAT captures subtle attitudes that might not be as effectively measured through self-reports or explicit measures (Greenwald & Banaji, 1995). When gender stereotypical notions were inspected using explicit and implicit measures, the findings consistently showed that stereotypes were evident at the implicit levels (Nürnberger et al., 2016). The discrepancy between what is consciously and unconsciously expressed indicates that what serves as a ground for implicit bias can potentially develop over time into explicit attitudes (Cvencek et al., 2021). Female engineering students, for example, had weaker implicit gender-math and gender-reasoning stereotypes than females in the humanities (Smeding, 2012). This demonstrates that implicit association may not be fixed and can be influenced by various factors. The result of the IAT in this current study can be attributed to the diversity of implicit beliefs among the sampled teachers. Teachers, as individuals, may hold a wide range of attitudes and beliefs, leading to variability in implicit biases within the sample. Further exploration is needed to understand the nature of implicit association within this context.

On the other hand, a notable limitation of this study was the inability to establish a fully controlled and administered environment for the IAT. Distraction and external influences beyond the researcher's control might have affected participants' responses. Future investigations must address more targeted strategies, such as administering the IAT over multiple sessions or setting it in a more controlled environment. Additionally, conducting longitudinal approaches with an intervention can help track changes in implicit biases over time.It is essential to acknowledge that exploring teachers' intrinsic association, especially concerning gender and subject categories, remains relatively underexplored in existing literature (Bordalo et al., 2016; Carlana, 2019). Most educational research has focused on ethnicity (e.g., Pit-ten Cate & Glock, 2019; Quinn, 2020). The current exploration sets the foundation for further investigations into the dynamics of gender-related biases in mathematics education in Lebanon.

Descriptive and Demographic Perspectives into Teachers' Gender Stereotypes in Mathematics

The aim of this study was to explore patterns affecting teachers' gender-stereotypical beliefs in mathematics (H3). Descriptive statistics suggested gender-stereotypical assumptions where teachers tended to believe in a gender-based disparity in mathematics career encouragement for boys and associated mathematical careers with boys' interests. Additionally, teachers collectively reflected less agreement with attributing boys' mathematical competence to the easiness of tests and support from others compared to girls. Such observations suggested that teachers perceived other factors beyond the ease of the test and support as influencing the greater mathematical achievement, or that there was a potential tendency to generate differentiated attributions. Teachers in various studies have attributed boys' mathematics success to ability and girls' to effort (Bonefeld et al., 2020; Espinoza et al., 2014; Fennema et al., 1990; Sarouphim & Chartouny, 2017; Schober & Finsterwald, 2016; Tiedemann, 2002; Tindall & Hamil, 2004). Further research is vital for exploring whether gender stereotypes initiate teachers' attribution to students' mathematics success.

The findings from the ANOVAs revealed differences between teachers' demographic characteristics regarding their gender-stereotypical beliefs. The results of statistically significant gender-stereotypical disparities between female and male teachers regarding boys' competence and mathematics career perceptions, but not in attributing

mathematics achievement, are consistent with Tajfel's (1970) Social Identity Theory (as examined by Scheepers & Ellemers, 2019). According to this theory, people have a positive bias towards their own social groups. The greater gender stereotype about boys' abilities and career suitability among male teachers might be attributed to each gender group desiring to portray their own gender more favourably. However, the tendency of female teachers to disagree with attributing males' performance solely to the ease of the examination and external support, compared to girls, points to an interesting avenue for future research. This conclusion is possibly consistent with previous research (Depaepe et al., 2016; Espinoza et al., 2014; Gunderson et al., 2012, 2017) that credits boys' success to innate intellect rather than malleable factors (Dweck, 2007, 1986) or consistent with the finding of female teachers being more biased than male teachers (Cimpian et al., 2014). Further research is needed to uncover the motivation or influences producing such perspectives.

There were further statistically significant differences between female and male teachers and an interaction involving gender, age, education, and religion, pointing to the multi-dimensional nature of these beliefs. Socio-demographic characteristics can be useful in predicting people's attitudes. In Andersen's study (2023), s/he/they revealed that gender bias varied with teachers' demographic characteristics and cultural variables. There were some marginal group differences by religious affiliation, but these were small and inconsistent. Religiosity has been reported to be related to gender role attitudes and stereotypes in previous literature (Diehl et al., 2009; Greenburg & Gaia, 2019). This is not what was found in the current study. Further exploration would be needed to draw definitive conclusions about the reasons behind this study's results. One possible limitation of this study could be that the measures for assessing teachers' perceptions relied on a Likert scale that assessed their stereotypes directly. These methods are susceptible to social desirability bias, where participants provide responses they perceive as socially acceptable (Greenwald & Banaji, 1995). This could have affected the accuracy of the data. Future research should consider utilising observational methods, such as classroom observation, or directly assessing teachers' behaviours and reactions in natural educational settings. This approach might be more objective and provide a clearer view of how gender-related biases manifest in student interactions.

It is also important to acknowledge the gender disparity in the sample and the inability to access public school teachers, which are limitations of the study. This limitation could have potentially impacted the results and, thus, their generalisability to the wider population. Future research could also examine if similar gendered beliefs appear in subjects other than mathematics. It may also be useful to explore how teacher education or professional development affects how teachers think about gender and ability. These studies could help identify what training or experiences shape teachers' beliefs. Including teachers from public schools would also make it easier to understand how school type and broader institutional settings influence gendered perceptions. Future interventions should also include training modules that address implicit bias in subject evaluation. These could include case-based discussions, reflection exercises, and video modelling to help teachers identify incidents of stereotypes in expectations and assessment. In the Lebanese context, implicit bias training could be integrated into in-service teacher development programs coordinated by the Ministry of Education or teacher syndicates. Additionally, pre-service teacher education curricula could include content on stereotype formation, unconscious bias, and gender equity strategies within subject instruction.

Conclusion

This study adds to a growing body of work exploring how both implicit and explicit teacher beliefs contribute to gendered patterns in education, especially in under-researched regions. It examined how teachers evaluate students' mathematical achievement in relation to gender, their unconscious associations between gender and academic domains, and their explicit beliefs about gender and mathematics. The results showed clear evidence of gender-stereotypical beliefs in mathematics in career encouragement and competence perceptions, with male, older, and less qualified teachers more likely to endorse such views. The findings showed that teachers' beliefs varied by demographic factors, including gender, age, and education, with some slight and inconclusive differences observed by religious affiliation. This study calls for more targeted research to investigate the influences shaping teachers' perceptions of mathematics, such as longitudinal studies that track changes in teacher perceptions over time. Combining experimental, implicit, and self-report measures, this study paves the way for further research to recognise and respond to gender bias in educational settings.

Statements and Declarations

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