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Why Don't Girls Choose Technological Studies? Adolescents' Stereotypes and Attitudes towards Studies Related to Medicine or Engineering

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Gender differences in choice of studies emerge already in adolescence. Two studies with adolescents are presented, the goal of which is to explore the influence of gender by assessing males and females who choose studies related to Medicine or Engineering. Study 1, correlational (N = 330, mean age 15.9, 56.7% girls), shows that girls who choose technology are more poorly appraised than girls who choose other studies. Study 2 (N = 130; mean age 16.77, 56.2% girls), experimental, measures implicit attitudes (using the IAT) towards males and females from Medicine and Engineering. Implicit attitudes are more favorable towards women if they are studying Medicine and towards men if they study Engineering. The results are analyzed with relation to the percentages of boys and girls in the different fields of study.

Keywords: Career choice, gender stereotypes, gender attitudes, adolescence, IAT.

Las diferencias de género en elección de estudios aparecen ya en la adolescencia. Se presentan dos estudios con muestras de adolescentes, cuyo objetivo es explorar la influencia del género al evaluar a hombres y mujeres que eligen estudios relacionados con Medicina o con Ingeniería. El estudio 1, correlacional (N = 330; media de edad 15,9), muestra que la chica de tecnología es peor evaluada que la que elige otro tipo de estudios. El estudio 2 (N = 130; media de edad 17,8), experimental, mide actitudes implícitas (utilizando el IAT) hacia hombres y mujeres de Medicina e Ingeniería. Las actitudes implícitas hacia las mujeres son más favorables si pertenecen a Medicina y hacia los hombres si pertenecen a Ingeniería. Los resultados se analizan en relación con las tasas de chicas y chicos en las distintas ramas de estudio.

Palabras clave: elección de estudios, estereotipos de género, actitudes de género, adolescencia, IAT.

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There is a preponderance of women in the Spanish universities since over more than a decade, but, if we look at the percentages of the sexes in certain study fields, such as Health Sciences (74.2% women) or Engineering (27.3% women), the data reveal very pronounced differences (Instituto de la Mujer, 2009, data from 2005-6)[1]. In Spain, where this investigation was carried out, in the university studies, both Medicine and Engineering are considered to be quite prestigious careers, partly because of the difficulty to gain access to them, and partly because of the difficulty of the material. In order to enroll in these careers, students need a much higher average middle-education grade than for other careers. In addition, the employment rate in these professional sectors is currently much higher than in others. In an investigation carried out by the Centro de Investigación y Documentación Educativa (CIDE; in English, the Center of Research and Educational Documentation) of the Ministry of Education at the end of the 1980s with a sample of first-year university students of various careers, Engineering careers were the studies that scored highest in difficulty, prestige, employment, and money. Medicine came second in all these criteria, except for employment (CIDE, Instituto de la Mujer [Women's Institute], 1988). Although there are no recent studies about the rating of studies that confirm these results, there have been no social changes to make one think that this rating may have changed and the careers of Engineering and Medicine can still be considered to be highly valued in these characteristics by students.

This situation is common in other countries and reflects a completely generalized pattern in advanced countries. In the entire European Union (Eurostat, 2008), the percentage in 2005 of female graduates in Sciences, Mathematics, and Computer Science reached 39.17%, in Health Sciences 66.42%, and in Engineering 18.32%. Therefore, it does not mean that women reject sciences. The representation of women in careers of Medical or Biological Sciences and Chemistry is good, but not in Physics or in Engineering.

These differences in choice already appear in adolescence and will affect the future career from very early ages. The Spanish Secondary System (ESO) is compulsory until the age of 16. It comprises four courses (from the 1st to the 4th course) in which students' ages range between 12 and 16 years old. After ESO, students can choose between "Bachillerato " (hereafter, high school) or Professional vocation training (known as FP). High school comprises 2 years of non-compulsory secondary education prior to university studies: the 1st and 2nd course of high school. Students can choose four domains in high school: Technology, Humanities and Social Science (Humanities S.S.), Natural and Health Science (N.H. Sciences), and Arts. Once high school is completed, students have direct access to university studies. The students enrolled in Technological high school who wish to in pursue technological studies at university enter a Technological Engineering School.

The distribution of boys and girls in the high school modalities reveals differences that are remarkable if it is taken into account that this generation was formed in values of equality, and that girls and boys share the same classrooms, so they know there are no gender differences in academic aptitudes. According to the data of the Global Gender Gap Index 2007 (Hausman, Tyson, & Zahidis, 2008), Spain, the country where our research was performed, occupies the 10th position in the ranking of 128 countries (the United States occupies the 31st), and the 39th position in education (the United States occupies the 76th). In Spain, there are more girls (54.9%) in high school than boys and they achieve better school performance and have a lower rate of repeating courses (Grañeras, Del Olmo, Gil, García, & Boix, 2001). However, when choosing studies, sex differences are observed that are incongruent with achievement results. There is a higher rate of women in the Humanities (63.1%) and Natural and Health Sciences (50.7%) high school modalities. But in Technological high school, the percentage of women is much lower than that of men (20.7%). Art is also a feminine specialty of high school (64.6%); nevertheless, because this study modality is offered in very few centers, and only 3.9% of all the students registered in Spain choose it, it was not considered in this study (source: Instituto Nacional de Estadística [National Institute of Statistics], 2009). These choices in adolescence influence the possibility of choosing future university studies (Sáinz & González, 2008), and they are made at a crucial moment of the formation of adolescents' gender identity. Strangely, the modalities of Technology and Natural and Health Sciences are not very different in content, because they share, as compulsory subjects, Mathematics, Physics, and Chemistry, and they differ mainly in the subjects of Industrial Technology (compulsory in Technology) and in Biology and Geology (compulsory in Natural and Health Sciences).

The present research focuses on the choice of studies depending on gender at this early stage, in which students begin to orient their academic trajectory through their choice of high school modality. Specifically, the way that adolescents appraise people as a function of their studies was analyzed.

[1] The 2005-2006 course is the last one in which students' data, separated by sex and high school modalities, were published. The rest of the data were taken from the same course so they would be comparable.

The scarcity of women in technical fields has aroused enormous interest in the scientific community in the last few years (Bandura, Barbaranelly, Caprana, & Pastorelli, 2001; Barberá, Candela, & Ramos, 2008; Eccles, 2001, 2007; Eccles & Wigfield, 2002; Elejabeitia & López-Sáez, 2003; Köller, Schnabel, & Bäumert, 2001; Nosek, Banaji, & Greenwald, 2002; Ruiz-Ben, 2003; Stake & Nickens, 2005, among others). These studies share the need to find an explanation of why women, despite obtaining good grades and having equivalent conditions with those of men, still reject studies related to mathematics or technology.

The expectancy-value models propose that, when facing certain decisions, people take into account three types of information: the degree of personal attraction of each available option, considering both the positive and the negative aspects; the normative expectations of people or groups that are important for each individual; and the possible obstacles to achieve each alternative as a function of the available resources (Ajzen, 1991). According to this approach, the intention of a behavior such as the choice of studies is restricted if it is anticipated that important people from the environment will not value such a decision. When choosing a career, expectations of success, long-term goals, and gender role schemas also have an impact, as well as the potential costs of dedicating oneself to a certain activity instead of to a different one (see Eccles, 1994, 2007). Physics and Technology careers are difficult. If boys find sufficient support from their parents, teachers, and peers to undertake them, they may feel compensated for such an effort. Likewise, if girls do not find the same degree of support to develop their aptitudes in these fields as they do in another type of sciences, such as Biology or Medicine, they may prefer to choose the latter type of careers, of similar difficulty and social prestige.

Differences in the appraisal of people depending on the type of studies they undertake are very much conditioned by gender stereotypes. Gender stereotypes create a series of expectations related to the descriptive norm (what women and men do) and the prescriptive norm (what they should do). According to the social role theory (Eagly, Wood, & Diekman, 2000), individuals who do not fulfill these expectations are punished. Prejudice against women occupying traditionally masculine roles lies in the perception of incongruity between the characteristics required for such a role and stereotyped beliefs about women (Eagly & Karau, 2002).

The influence of parents' gender prejudices has also been verified (Eccles, Barber, & Jozefowicz, 1999; Frome & Eccles, 1998; Updegraff, McHale, & Crouter, 1996), as well as the influence of teachers and guidance counselors (Ayalon, 2003; Fagot, Rodgers, & Leinbach, 2000) on girls' and boys' choice of studies. No doubt, friends and peer group also play an important role in adolescents' choices (Stake & Nickens, 2005). At this age, social acceptance by classmates is important, and identity according to gender roles can be crucial to obtain the desired group approval. In a qualitative study with Spanish adolescents, it was verified that the prototype of a high school student of Natural and Health Sciences is female, highly valued for her qualities, whereas the prototype of a Technological high school student is male. Moreover, according to this study, the prototype of a girl who chooses the Technological high school modality has the most negative qualities, in comparison to the rest of the high school students, in the opinion of her classmates and companions (López-Sáez, Puertas, & Sáinz, 2008). This negative appraisal of females in a traditionally masculine role did not emerge when assessing the prototype of a male student in a Humanities high school modality, where males are a minority. In this sense, research has also shown that those girls who like science or excel in scientific subjects are rated higher in masculine traits by their peers and are less popular, especially among their male counterparts (Breakwell, Vignoles, & Robertson, 2003; Kessels, 2005).

Study preferences are related to the match between the self and the prototype of a person who studies a certain subject (Hannover & Kessels, 2004). From this approach, if adolescents harbor negative stereotyped beliefs towards the prototype of females who study technological studies, these kinds of studies will hardly be chosen by girls when they imagine the person they wish to be in the future. Likewise, if the prototype includes positive beliefs, it will be easy for it to match the desired self and more likely for a girl to tend to choose that field of studies (Kessels, 2005; Kessels & Hannover, 2008). According to Cantor and Mischel (1979), the prototype describes an individual who represents the group, based on stereotyped beliefs associated with the individual's group, and people who belong to a certain group are judged by comparing them to the prototype. In the above-mentioned qualitative study, carried out with a sample of Spanish adolescents, it was verified that the prototype of girls who choose technological studies does not match expectations that are congruent with gender stereotypes, because these girls are considered masculine and they are mainly described with negative characteristics. The opposite occurred with the girls who chose studies related to Natural and Health Sciences, a prototype associated with femininity and described with highly positive characteristics (López-Sáez et al., 2008). If adolescents consider Technology to be a masculine field, and the women who choose this type of studies are not positively valued, it seems logical for girls to reject these studies and to choose studies in which they will feel more positively valued.

Using the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998), various authors have found that physics or mathematics are more closely associated with masculinity than with femininity (Kessels, Rau, &

Hannover, 2006; Nosek, Banaji, & Greenwald, 2002; Nosek et al., 2009) or that gender stereotypes are related to some professions (White & White, 2006). These studies were carried out among samples of university students and in them, Science studies were compared with nonscientific studies, such as Art or English. In Spain and in other countries, women do not reject scientific careers but they do specifically reject the branch of technology. This rejection already appears in adolescents' choices.

The main purpose of this research is to explore gender stereotypes and attitudes associated with the different types of studies and with the people who choose them, in a sample of Secondary Education students, in order to support the relation between such beliefs and attitudes and the percentages of study choice. For this purpose, two studies with samples of adolescents were carried out, using different methodologies. The first one, a correlational study, measures gender stereotypes and explicit attitudes associated with each high school modality. In the second study, implicit attitudes towards the professionals of Medicine and Engineering (both of them scientific) are analyzed in order to confirm the influence of gender in this type of automatic associations. Specifically, we expect that adolescents will show stereotyped beliefs towards the technological high school, with which they will associate masculinity, and more negative attitudes towards the women who choose this type of studies.

Study 1

Stereotypes and Explicit Attitudes related to High School Modalities

This study explores gender stereotypes towards the different high school modalities and gender stereotypes and explicit attitudes towards the people who choose each one of these study modalities. Specifically, we attempted to cover the following goals with this study: 1) to analyze the existence of gender stereotyping associated with the different high school modalities, 2) to analyze the existence of gender stereotyping about the boys and girls who study each one of the high school modalities, and 3) to analyze the influence of gender on the attitudes towards boys and girls from different high school modalities.

With regard to our goals, the following findings were expected: 1) Technological high school is considered more masculine than other modalities; 2) girls and boys from Technological high school will be perceived as being more masculine than those from other modalities; 3) if gender is not salient, there will be no differences in attitudes towards people from the high school modalities; and 4) attitudes towards girls from Technological high school will be more negative than towards girls from the other high school modalities.

Method

Participants and Procedure

In this study, there were 330 (56.7% girls) participants, adolescents from various regions of Spain (mean age 15.9 years, $SD = 0.83$), randomly selected in public and concerted schools whose personnel were interested in participating in the research project. They all belonged to the course in which they have to decide which high school modality they will choose for the following school year. The participants completed the questionnaire in the classroom of their study center. The questions were presented as a survey to gather information about the different aspects of high school and the students were ensured of the anonymity and confidentiality of the obtained data. Afterwards, the real purpose of the study was explained to them.

Measures

The scales of the questionnaire were presented in a fixed order. To measure gender stereotyping associated with each high school modality, a scale ranging from +5 (*masculine*) to -5 (*feminine*), with a neutral point at 0, was used. Three modalities were assessed: Technology, Natural and Health Science and Humanities and Social Science. Participants answered the following question: "(name of modality) high school suggests…..to me," They were subsequently provided with a series of adjectives in the form of a semantic differential, among which were included "feminine-masculine", while the rest of the adjectives were distracters. We used a bipolar unidimensional measure of gender stereotypes because, according to Bem (1993), people tend to polarize gender differences, so that what is considered feminine is not considered masculine and vice versa. According to this assumption, Biernat (1991) found that masculine and feminine components were seen opposite ends of a single dimension in adolescents' gender stereotypes.

To measure attitudes towards the individuals in each high school modality -without specifying gender- they rated how much they liked people who studied that modality on a 10-point Likert scale ranging from 0 (*not at all*) to 10 (*very much*).

Attitudes towards female students who chose each high school modality were measured with a semantic differential with 18 positive and negative adjectives (i.e., capable-incapable, fun-boring, ugly-beautiful), ranging from +5 to -5, with a neutral score at 0, on which they rated the characteristics they allocated to the girls who studied each of the high school modalities. The mean was weighted by dividing the sum of the items by 18. Higher scores indicated a more positive attitude. Item 19 of these scales included the adjectives "feminine-masculine," and measured gender stereotyping with regard to the girls who studied each of the high school modalities (-5 = *masculine*, +5 = *feminine*).

The same procedure was used to measure gender attitudes and stereotyping (scale: +5 = *masculine* to -5 = *feminine*) towards male who chose each high school modality. All alpha values exceeded .91 (see Table 4).

Results

Gender Stereotyping Associated with High School Modalities

The means of all the high school modalities, in terms of femininity-masculinity, were close to point 0 (Table 1). That is, none was considered either very feminine or very masculine, but instead rather neutral in relation to gender. Nevertheless, the high school modality that was perceived as more feminine is Humanities and Social Sciences (Humanities S.S.), followed by Natural and Health Sciences (N.H. Sciences), and Technological high school scored highest in masculinity, in accordance with our hypotheses (Friedman test: *Chi-square* (2) = 26.12, $p < .001$) . Comparing N.H. Sciences high school with Humanities S.S., these differences were significant, $t(329) = 2.99$, $p < .003$. The differences between Technological high school and N.H. Sciences, $t(329) = 4.68$, $p < .001$), and Humanities S.S., $t(329) = 7.64$, $p < .001$, were also significant.

Participants' gender affected their perception of femininity-masculinity of N.H. Sciences high school, $F(1, 329) = 15.1$, $p < .001$, and of Humanities S.S., $F(1,329) = 21.7$, $p < .001$. N.H. Sciences high school was perceived as more feminine by the girls and Humanities S.S. was perceived as more feminine by the boys. Differences between participants in Technological high school were nonsignificant, $F(1,329) = .93$, $p = .33$.

Gender Stereotyping about Female and Male Students Enrolled in each High School Modality

The adolescents believed that the most feminine girls study N.H. Sciences, followed by the girls who study Humanities S.S., and the girls from Technological high school were considered the least feminine (Friedman test: *Chi-square* (2) = 64.8, $p < .001$). In the pairwise comparisons of the mean scores in these variables, the stereotypes of femininity of the girls from N.H. Sciences and Humanities S.S. were not statistically significant, $t(329) = 0.05$, $p = .96$. In accordance with our hypotheses, the girls from Technological high school were considered significantly less feminine than the girls from N.H. Sciences, $t(329) =$

Table 1
Means and Standard Deviations of Attribution of Femininity and Masculinity to high School Modalities as a Function of Participants' Sex

Participants' Sex	N.H. Sciences *M* (*SD*)	Humanities S.S. *M* (*SD*)	Technological High School *M* (*SD*)
Girls	-.35 (2.2)	.86 (2.1)	.76 (2.3)
Boys	.69 (2.5)	-.24 (2.1)	1.01 (2.3)
Total	.11 (2.4)	.38 (2.1)	.87 (2.3)

Note. Higher scores indicate more masculinity.

Table 2
Means and Standard Deviations of Attribution of Femininity and Masculinity to Diverse high School Modalities according to Target's Sex

	M	*SD*
Female		
N.H. Sciences	2.19	2.56
Humanities S.S.	2.17	2.54
Technological High School	1.14	2.83
Male		
N.H. Sciences	1.55	2.71
Humanities S.S.	1.61	2.75
Technological High School	2.01	2.62

Note. Higher scores indicate more femininity when assessing female target and more masculinity when assessing male target.

6.33, $p < .001$, and than those from Humanities S.S., $t(329) = 6.26$, $p < .001$ (see Table 2).

When assessing the masculinity of the boys, they believed that the most masculine boys are those who study Technological high school, followed by Humanities S.S., and the least masculine are those who study N.H. Sciences (Friedman test: *Chi-square* (2) = 15.6, $p <$. 001). Pairwise comparison of the means of these variables showed that Technological high school is different from N.H. Sciences, $t(329) = 3.65$, $p < .001$, and from Humanities S.S., $t(329) = 2.78$, $p < .006$. The differences in masculinity attributed to boys from N.H. Sciences and to those from Humanities S.S. were nonsignificant: t (310) = .30, $p = .75$.

Considering participants' gender, stereotype differences were only found in the perception of boys from N.H. Sciences high school, $F(1,329) = 3.94$, $p < .05$, to whom the girls attributed more masculinity ($M = 1.82$, $SD = 2.50$) than did the boys ($M = 1.21$, $SD = 2.9$). There were no statistically significant differences amongst the rest. Therefore, independently of whether they were girls or boys, there was considerable consensus among the adolescents about what the boys and girls who study each high school modality are like in terms of femininity and masculinity.

Attitudes towards Female and Male Students who Chose one of the High School Modalities

Firstly, attitudes in general were analyzed—without specifying gender—towards the individuals who study each high school modality. The most positive attitudes were displayed towards the people from N.H. Sciences, followed by Humanities S.S. The people who studied Technological high school received the worst appraisal (see Table 3). Nevertheless, according to our hypothesis, the differences between the means of these variables were not statistically significant (Friedman test: *Chi-square* (2) = 2.9, $p = .23$). Comparing the scores of the participant boys and girls in these three variables, the girls were observed to display a more positive attitude than the boys towards individuals from all the high school modalities, except for Technological high school, in which the boys expressed a more positive attitude. These differences were statistically significant for the Technological high school, $F(1,329) = 6.89$, $p < .009$, but not for the modalities of N.H. Sciences, $F(1,329) = 3.26$, $p = .07$, and Humanities, S.S. , $F(1,329) = 3.02$, $p = .08$.

In each high school modality, differences in attitudes as a function of the stimulus' gender and the participants' sex were analyzed, by means of a 2 (Stimulus' gender: female vs. male) x 2 (Participants' sex: girls vs. boys) design. The first two variables were between-subject and the last one was within-subject.

In N.H. Science, main effects of stimulus' gender $F(1,329) = 19.43$, $p < .001$, $\eta^2 = .06$, and of participants' sex were found, $F(1,329) = 4.54$, $p < .034$, $\eta^2 = .02$, but the interaction was not significant, $F(1,329) = .05$, $p = .828$. Attitudes towards women who study this modality of high school is better than attitudes towards the men, and the girls of our sample displayed more positive attitudes than the boys. In the Humanities S.S. modality, the results were similar. Main effects of stimulus' gender, $F(1,329) = 22.04$, $p < .001$, $\eta^2 = .07$, and participants' sex were found, $F(1,329) = 9.2$, $p < .003$, $\eta^2 = .02$, and the interaction was nonsignificant, $F(1,329) = 1.02$, $p = .321$. Attitudes were more favorable when the stimulus was female, and the girls of our sample showed more favorable attitudes than the boys. Regarding the Technology modality, no differences were found either as a function of stimulus' gender, $F(1,329) = 3.45$, $p = .06$, or participants' sex, $F(1,329) = 1.05$, $p = .306$. The interaction was significant $F(1,329) = 3.87$, $p < .05$, $\eta^2 = .01$: The girls rated the stimulus more highly when it was female, whereas in the boys, this rating was the same, regardless of stimulus' gender (see Table 4). Therefore, girls were more highly valued than boys in any of the modalities, except for Technology, in which there were no gender differences. That is, contrary to expectations, in this typically masculine modality, we did not observe a more favorable attitude towards men than towards women.

We compared the attitudes towards the girls and towards the boys of each high school modality. The analysis of the attitudes towards girls who study various high school modalities showed that the girls who chose N.H. Sciences

Table 3
Means and Standard Deviations of Attitudes towards People in Diverse high School Modalities depending on Participants' Sex

Participants' Sex	N.H. Sciences *M* (*SD*)	Humanities S.S. *M* (*SD*)	Technological High School *M* (*SD*)
Girls	6.43 (2.4)	6.40 (2.4)	5.74 (2.4)
Boys	5.94 (2.5)	5.94 (2.4)	6.44 (2.4)
Total	6.22 (2.5)	6.20 (2.4)	6.04 (2.5)

high school evoked more positive attitudes (M = 2.51, SD = 1.4), followed by the girls who chose Humanities S.S. (M = 2.46, SD =1.5), although the differences between these two variables were nonsignificant: $t(329) = .56$, $p = .52$ (Friedman test: *Chi-square* (2) = 9.34, $p <$. 009). Girls who chose Technological high school obtained the lowest score (M = 2.23, SD = 1.6), evoking a less positive attitude than girls from N.H. Sciences high school, $t(329) = 2.97$, $p < .003$, and also less positive than those from Humanities S.S. high school, $t(329) = 2.75$, $p < .006$. With regard to participants' gender differences, in all cases ($p < .05$), the girls' attitudes were significantly more positive than those of the boys (see Table 4).

Regarding attitudes towards the boys, the order of appraisal was: Humanities S.S. (M = 2.14, SD = 1.6), N.H. Sciences (M = 2.12, SD = 1.6), and Technological high school (M = 2.10, SD = 1.5). Nevertheless, none of these differences were statistically significant (Friedman test: *Chi-square* (2) = .381, p = .82). The differences among the participants showed that the girls scored higher than the boys in attitudes towards boys. These differences between boys and girls were significant in the case of the attitudes towards boys from Humanities S.S., but not when appraising boys from N.H. Sciences or from Technological high school. It is also noteworthy that in the case of the boys, the most positive attitude was towards boys who study Technological high school (M = 2.08), a difference that almost reached significance in the comparison of the means in attitudes towards boys from Humanities S.S. (M = 1.93), $t(142) = 1.90$, $p < .06$ (see Table 4).

Discussion

Adolescents' viewpoint of the femininity-masculinity of the various modalities of high school is basically neutral. Nevertheless, some stereotyping is detected, which coincides with the differences in the percentages of girls and boys in each one of these modalities. They consider Humanities S.S. high school to be the most feminine, and the Technological high school to be the most masculine, with N.H. Sciences at an intermediate point, but within the masculinity side of the scale.

Regarding stereotyped beliefs about female and male students who choose each high school modality, the adolescents believe that the most feminine girls are the ones from N.H. Sciences., followed by those from Humanities S.S., and the girls who choose Technological high school are considered the least feminine. Nevertheless, all of them are considered feminine. When attributing the trait of masculinity to the boys, the highest score is allocated to the boys from Technological high school, followed by those from Humanities S.S., and lastly, N.H. Sciences. It is important to note that in the attribution of the traits of femininity-masculinity, both to female and to male students, only the Technological modality was different from the rest. That is, the girls from the Technological high school were attributed less femininity than the rest; the boys from Technological high schools were attributed more masculinity than the rest, and there were no differences in this gender attribution in the other high school modalities. No noteworthy differences in these stereotyped beliefs between the participant girls and boys were observed.

When no mention of gender is made, the general attitudes towards the people who choose each one of the three modalities falls in the intermediate range of the scale, with no significant differences among the types of high school. Upon comparing the scores of the girls and boys participants, a more positive attitude is observed in the girls towards people from Humanities S.S. and N.H. Sciences, and the boys have a more positive attitude towards the people from Technological high school.

Table 4
Attitudes (Means and Standard Deviations) towards Female and Male Students who chose Diverse High School Modalities by Participants' Sex

High School Modalities	Participants' Sex		
	Girls *M* (*SD*)	Boys *M* (*SD*)	Total *M* (*SD*)
Female students			
N.H. Sciences (α = .91)	2.68 (1.2)	2.26 (1.6)	2.51 (1.4)
Humanities S.S. (α = .93)	2.75 (1.3)	2.08 (1.8)	2.46 (1.5)
Technological High School (α = .93)	2.41 (1.3)	2.01 (1.8)	2.23 (1.6)
Male students			
N.H. Sciences (α = .93)	2.26 (1.5)	1.93 (1.7)	2.12 (1.6)
Humanities S.S. (α = .93)	2.29 (1.5)	1.93 (1.6)	2.14 (1.6)
Technological High School (α = .92)	2.12 (1.4)	2.08 (1.6)	2.10 (1.5)

When analyzing attitudes towards the girls, it is noteworthy that the girls from Technological high school are more negatively assessed than the girls from the other two modalities. With regard to attitudes towards the male students, no differences were found when comparing the diverse high schools. The gender differences of the participants show that the boys value boys from the Technological high school more than they value those of the other high school modalities, whereas the girls value them the least.

Summing up these results, one could conclude that the profile of Technological high school is the one that is more different from the other two high school modalities and that it has some characteristics that are more closely associated with gender differences, insofar as stereotypes like the appraisal received by people of either sex who choose this type of studies.

The data from this first study coincide with the results obtained in a similar sample using a qualitative technique which show that adolescents are prejudiced towards the girls who choose technological studies (López-Sáez et al., 2008). This prejudice is specifically linked to gender because it is not displayed towards the boys who choose this type of studies. However, we did not find that boys from the Technology modality were rated higher than the girls. These prejudices could involve a great obstacle for the girls who choose technological studies and could explain the gender differences in the choice rates of this type of studies. In this first correlational study, the relation between gender and girls' and boys' explicit attitudes towards Technology or Health Sciences was measured. Our second study attempts to verify, by means of a technique of measurement of implicit attitudes and an experimental design, whether there is interaction between type of career and gender, in the evaluation of professionals of Medicine and Engineering, two scientific careers with gender differences in the ratios.

Study 2

Implicit Attitudes towards Men and Women from Medicine and Engineering

In this study, we investigate whether adolescents' evaluation of professionals of Medicine or Engineering is conditioned by the professionals' gender. Specifically, we wish to explore whether the automatic "good/bad" association of professionals of Medicine and Engineering varies as a function of whether those professionals are male or female.

We examine the automatic component of attitudes towards professionals of Medicine and Engineering, comparing males and females from both professions. For this purpose, we used a measurement of implicit attitudes, the Implicit Association Test (IAT; Greenwald et al., 1998). For some authors (see Eagly & Chaiken, 2005), these implicit measures reflect associations that are frequent in certain environments and that may be culturally determined.

The IAT measures the implicit beliefs and attitudes of people by means of the automatic assessment that underlies this process. It has the advantage that it allows one to successfully measure preferences among objects in contexts that are affected by social desirability, such as those related to gender stereotypes and prejudices. This instrument has been extensively used in numerous investigations and with very diverse social groups, and, specifically, in gender prejudices (i.e., Rudman, Greenwald, & Mcghee, 2001), or relations between gender and professions (i.e., Kessels et al., 2006; Nosek et al., 2002; Nosek et al., 2009; White & White, 2006). Its use in numerous investigations with very diverse social groups has allowed the verification of its adequate psychometric properties (i.e., Asendorpf, Banse, & Mücke, 2002; Banse, Seise, & Zerbes 2001; Greenwald et al., 1998; McConnell & Leibold, 2001; Rudman, Greenwald, Mellot, & Schwartz, 1999; Swanson, Rudman, & Greenwald, 2001). The characteristic of masking, typical of implicit measures, does not mean that the IAT ensures that the measure is real and that it has no limitations. Various authors have found evidence of the malleability of implicit attitudes and prejudice due to the familiarity of the words used -which acts as a facilitating factor of the tasks- or the effects of the context (Blair, 2002; Dasgupta & Greenwald, 2001; Dasgupta, McGhee, Greenwald, & Banaji, 2000; Ottaway, Hayden, & Oakes, 2001; Rudman, et al., 1999).

The distinct feature of the IAT is that preference for one concept (e.g., Medicine) is measured in comparison with preference for another concept (e.g., Engineering). This comparison permits contrasting attitudes towards different social categories, in our case, women and men from different professions. To examine these relations between attitudes and categories, the study focused on the following implicit associations: (a) the association between Medicine versus Engineering and *good-bad*, (b) the association between Medicine versus Engineering and *good-bad* when the stimulus is a woman, and (c) the association between Medicine versus Engineering and *good-bad* when the stimulus is a man.

The following hypotheses were proposed:

1. There will be no differences in implicit attitudes towards Medicine and Engineering; that is, when comparing the responses to Medicine/*good* versus Engineering/*bad* with Engineering/*good* versus Medicine/*bad*, no differences in participants' reaction times will be observed.
2. There will be an interaction between implicit attitudes towards Medicine and Engineering and stimulus' gender. As a consequence of this interaction, the following hypotheses were formulated:
    - 2a. The participants will value the female doctor more than the female engineer. Consequently, when the stimulus is a woman, when

presenting a word related to Medicine with something good (e.g., antibiotic + happy) or with something bad (e.g., antibiotic + sadness), they will respond more quickly if the category and the assessment are congruent (female doctor-good) than when it is incongruent (female doctor-bad). Likewise, they will tend to associate the category female engineer with more negative than positive characteristics and, therefore, they will answer more quickly when the category and the assessment are congruent (e.g., motor + sadness) than when it is incongruent (e.g., motor + happy). When comparing the evaluation of the female doctor with that of the female engineer, the participants will respond more quickly when the evaluation is congruent with their attitudes (female-doctor-good/female engineer-bad) than when it is incongruent (female-doctor-bad/female engineer-good).

2b. In the case of male stimuli, the association will be inverted, and the male engineer will be better valued than the male doctor. Therefore, when comparing the male engineer with the male doctor, the more positive evaluation of the male engineer versus the male doctor will be reflected in the participants' responding more quickly when the evaluation is congruent with their attitudes (male engineer-good/male doctor-bad) than when it is incongruent (male engineer-bad/male doctor-good).

Method

Participants

To avoid in-group bias, we selected students from the first course of the modality of Humanities S.S., that is, the group of high school whose studies were not related to the categories assessed herein: Medicine and Technology. The sample was made up of 130 students from various centers of the Region of Madrid who participated voluntarily in the study (mean age 16.77 years, *SD* = 0.94), of whom 56.2% were girls. They were randomly assigned to one of the four experimental groups, using a 2 (male or female stimulus) x 2 (presentation order of the critical blocks) factorial design.

Measures

A prior study was carried out to select the words associated with Medicine and Engineering. Ninety-six secondary students (58.2% girls) of high school (mean age 17.8 years, *SD* = 1.24) completed a questionnaire that included 62 words associated with Engineering or Medicine, alphabetically arranged (this order was counterbalanced). The participants rated, on a 7-point Likert scale, ranging from 1 (*Engineering*) to 7 (*Medicine*), which of the two professions was more closely associated with each word. After collecting the data, it was analyzed, selecting the nouns that showed a closer association with the proposed categories.

As is typical with studies that apply the IAT, the task is carried out in seven blocks, five trial blocks and two in which the reaction times are measured (see Puertas, Rodríguez-Bailón, & Moya, 2002, for a detailed description). In this task, which measured attitudes towards males and females of Medicine and Engineering, depending on the experimental condition, participants classify the diverse words referring to the following categories: female doctor versus female engineer or male doctor versus male engineer, combined with good versus bad.

The four categories that appeared on the computer, to the left and right of the screen were: "Good," "Bad," "Female Engineer" (in Spanish, "Ingeniera") and "Female Doctor" (in Spanish, "Médica")—when the stimulus was female—and "Male Engineer" (in Spanish, "Ingeniero") and "Male Doctor" (in Spanish, "Médico")—when it was male[2]. The participants had to classify the following words in these categories: (a) good: pretty, excellent, happy, smile, clean, healthy, cultured, triumph, joyful, brilliant; (b) bad: ugly, awful, dirty, horrible, crying, infernal, sad, rude, uncultured, failure; (c) engineer [female or male]: aerodynamic, construction, electricity, tool, engineering, motor, plan, workshop, highway, radio; and (d) doctor [female or male]: food, antibiotic, biology, dose, pharmacy, hospital, nutrition, pill, tablet, prescription.

Implicit attitudes towards the men and women from Medicine and Engineering were measured by means of participants' mean reaction time (RT) in the critical blocks. Responses with a RT lower than 300 ms (anticipatory) and higher than 10,000 ms (controlled) were eliminated. Of the diverse measures proposed by Greenwald, Nosek, and Banaji (2003), we chose this conventional measurement because it allows us to clearly contrast the hypothesis of interaction

[2] Translator's note: like most nouns in Spanish, the words *engineer* and *doctor* are either female (*ingeniera* and *médica*) or male (*ingeniero* and *médico*) depending on the word ending.

of the sex of the stimulus and RT. This measurement is appropriate for our sample and was used with samples of students (Nosek et. al., 2002) that are homogeneous in the characteristics that might affect task performance, such as age, or being accustomed to using computers.

Presentation order of the critical blocks was counterbalanced. Each experimental group responded to 1 out of the 4 types of IATs (two with the female stimulus and two with the male stimulus). One half of the participants responded first to the association that was congruent with the hypothesis (female doctor-good/female engineer-bad if the stimulus was female, and male engineer-good/male doctor-bad if the stimulus was male) and subsequently the incongruent association (female doctor-bad/female engineer-good if the stimulus was female, and male engineer-bad/ male doctor-good if it was male). The other half of the sample responded first to the association that was incongruent with the hypotheses and then to the congruent one. The effects of the order were not significant in any of the analyses, so they are not commented upon. Eighty-four participants responded to the female stimulus and 46 to the male stimulus.

Procedure

A member of the research team visited the participants' high schools after making an appointment with the headmaster. The task was carried out individually on portable computers, in a space prepared so the participants would be alone and isolated from any interference. The participants were randomly assigned to each one of the four experimental conditions. The task was presented as a study to test a didactic game of word association. The task was explained with a practical example and the participants were requested to carefully read the instructions that appeared on the computer in the trial blocks. After making sure there were no doubts about the procedure, the person in charge left the room so as not to interfere with the performance. After the completion of the task, the real purpose of the study was clarified to the participants.

Design

The study was carried out by means of a 2 (Stimulus' gender: woman vs. man) x 2 (Participants' sex: male vs. female) x 2 (Test: Doctor good/Engineer bad vs. Engineer good/Doctor bad) design. The first two variables were between-subject and the last one was within-subject.

Results

No main effects were found of the participants' sex, $F(1,126) = .001$, $p = .99$, or of the gender of the stimulus, $F(1,126) = .21$, $p = .65$, or of the interaction Participants' sex x gender of stimulus, $F(1,126) = 3.5$, $p = .06$.

In accordance with our hypotheses, no main effect of the test was found. There were no differences in RT between the association of Doctor-good/Engineer-bad ($M = 920.8$, $SD = 221$) and the association Engineer-good/Doctor-bad ($M = 959.8$, $SD = 219$), $F(1,126) = 0.07$, $p = .79$; although there was an interaction between these measures and the type of stimulus, $F(1,126) = 74.35$, $p < .001$, $\eta^2 = .37$. This effect reflects the difference in the RTs of the association Doctor-good/Engineer-bad when the stimulus is a woman ($M = 865.28$, $SD = 208$) or a man ($M = 1022.17$, $SD = 210$) and the association Engineer-good/Doctor-bad when the stimulus is a woman ($M = 1020.08$, $SD = 218$) or a man ($M = 849.84$, $SD = 174$). As can be seen in Figure 1, the RT of the association of Doctor with *good* and of Engineer with *bad* was lower if the stimulus was a woman. The RT of the association of Engineer with *good* and Doctor with *bad* was lower if the stimulus was a man. These data indicate that implicit attitudes towards female doctors are more positive than towards male doctors, and that attitudes towards male engineers are more positive than towards female engineers.

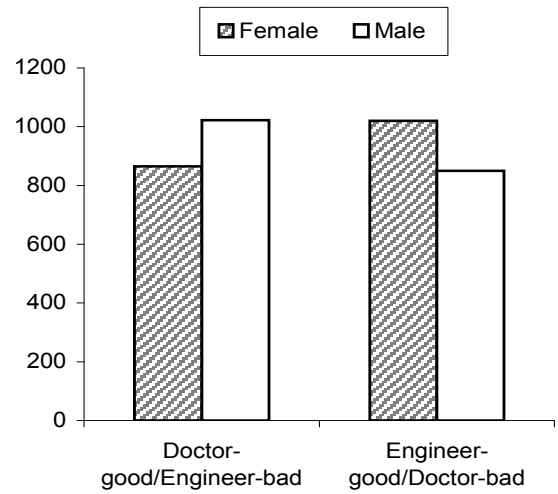

Figure 1. Reaction times (in ms) as a function of type of stimulus and test.

When the stimulus was a woman, an IAT effect was produced that supports our hypothesis. The participants responded more quickly to the association female Doctor-good/female Engineer-bad ($M = 865.28$) than to the association female Doctor-bad/female Engineer-good ($M = 1020.08$). This difference was statistically significant, $F(1,82) = 42.25$, $p < .001$, $\eta^2 = .34$. The effect of participants'

Table 5
Implicit Attitude (Mean Reaction Times in ms and Standard Deviations) towards Female or Male Doctors / Engineers

Stimulus´ gender	Test	*M* (*SD*)	*N*
Female	Doctor-good/Engineer-bad	865.28 (208)	84
	Engineer-good/Doctor-bad	1020.08 (218.7)	84
Male	Doctor-good/Engineer-bad	1022.17 (210.2)	46
	Engineer-good/Doctor-bad	849.84 (174.8)	46

sex was nonsignificant, $F(1,82) = 2.53$, $p = .12$.

When the stimulus was a man, the expected IAT effect was also produced. The participants responded more quickly to the association male Engineer-good/male Doctor-bad than to the association male Doctor-good/male Engineer-bad, $F(1,44) = 69.09$, $p < .0001$, $\eta^2 = .61$. In this case also, the effect of the variable participants' sex was nonsignificant, $F(1,44) = 1.42$, $p = .24$. Nevertheless, an interaction between the within-subject factor and the variable participants' sex was found, $F(1,44) = 9.22$, $p < .004$: The difference in RT between the congruent situation (male Engineer-good/male Doctor-bad) and the incongruent one (male Engineer-bad/male Doctor-good) was higher in the girls (difference = 225.48) than in the boys (difference = 96.79). That is, we found a higher IAT effect in the girls than in the boys.

Discussion

This study corroborates in part, by means of an experimental method, the results obtained with correlational methodology in the previous study about explicit attitudes towards students of N.H. Sciences and Technological high school. Automatic attitudes towards female doctors are more positive than towards female engineers, whereas attitudes towards male engineers are more positive than towards male doctors. When comparing men and women in each one of these two professions, attitudes towards female doctors are more positive than towards male doctors, and attitudes towards male engineers are more positive than towards female engineers. These results point in the same direction as those found in Study 1 with explicit measures and using correlational methodology when the stimulus was a woman. When the stimulus was a man, these differences in explicit attitudes were not found in the previous study. In implicit measures, the magnitude of both effects was much higher than in the explicit measures.

General Discussion

In the explicit measures that were analyzed in Study 1, we observed stereotyped beliefs and gender prejudices that affect adolescents' views of the diverse high school modalities and the people who study them. Gender stereotyping associated with high school modalities is mild. Nevertheless, Technological high school is considered more masculine than the rest (especially by the boys) and N.H. Sciences is considered more feminine (especially by the girls). Similarly, adolescents consider the girls who study N.H. Sciences more feminine and the boys who study Technological high school more masculine.

In general, without specifying the gender of the people who study them, no differences were observed in the ratings of the diverse high school modalities, except that the boys rated Technological high school more highly than the girls. When analyzing explicit attitudes towards the people who study these modalities taking stimulus' gender into account, our results show that women are more highly rated than men in any of the modalities, except for Technology, in which there were no gender differences. That is, contrary to expectations, in this typically masculine modality, we did not observe a more favorable attitude towards men. However, we found that girls from Technological high school were rated lower than girls from other modalities. But there were no differences among the boys.

The implicit attitudes of the adolescents of our Study 2 clearly reflect the prejudice associated with certain professions as a function of gender. As in Study 1, no differences in the rating of the profession were found, but there was a strong effect of the Profession x Stimulus' gender interaction, which reflects the way that women are rated higher if they study Medicine, and men if they study Engineering. Likewise, we verified that women are better rated than men in Medicine and worse than men in Engineering. These two occupations thus appear to be strongly gender stereotyped. However, in comparison to Study 1, Study 2 has shown that the implicit attitudes of our samples of adolescents clearly reflect the prejudice associated with certain professions as a function of gender.

No doubt, adolescents perceive these prejudices and this discrimination when choosing their professional trajectory. Specifically, when a girl chooses a career that goes against gender stereotypes, such as Engineering, she knows she will face negative appraisal from her classmates and companions. However, a girl who likes sciences and

mathematics knows that if she chooses Medicine instead of a professional future in Engineering, she will be much more highly valued socially. But, in the case of the boys, they know that they will be more highly valued if they choose Engineering rather than Medicine. Both types of career are difficult and demand aptitudes that are not possessed by all students. Nevertheless, the differences in this kind of aptitudes are not associated with gender and, therefore, they do not justify the different percentages in these careers observed in men and women. From our viewpoint, these are differences in social appraisal, which have been revealed in this work as one of the variables that could maintain these gender differences in choices.

As proposed by other authors (Eagly & Wood, 1999; Eagly et al., 2000), the differences in social appraisal that are perceived in certain professions and roles, depending on whether they are performed by a man or a woman, constitute a very important mechanism of social and cultural regulation. The profession of Medicine has become feminine, whereas Engineering is still a masculine territory. The origin of the prejudices against women carrying out certain traditionally masculine roles lies in the perception of incongruity between the characteristics required for such a role and the stereotyped beliefs about women (Eagly & Karau, 2002). In our study, these prejudices are displayed in adolescents' stereotypes of and attitudes towards women who choose technological studies.

Taking into account the importance for adolescents of gender identity and the peer group's appraisal, educational authorities should propose specific programs aimed at changing these negative perceptions, implementing programs that apply techniques to change stereotypes and attitudes. For example, Hannover and Kessels (2002) managed to modify the image of the prototype of an engineer by providing information that was inconsistent with the stereotypes. Such efforts should also be carried out in order to modify the prototypical image of the student who is good at domains and studies related to female-dominated areas, such as nursing or primary school teaching.

One of the assets of this study has to do with the use of adolescent samples, when analyzing stereotypes and attitudes that associate people with the diverse modalities of high school, at the time when they are considering the type of educational career they would like to study in the future. On the other hand, our study is different from others that have analyzed the relation between attitudes and stereotypes associated with typically feminine or masculine studies because it focused on the comparison of two types of studies, both scientific, but with very differentiated rates of men and women: *Technology and Engineering* and *Health Sciences and Medicine*. Therefore, from a general viewpoint, this investigation constitutes an original contribution to the study of gender differences in attitudes towards different academic choices in secondary education.

The results of this investigation are descriptive, so causal relations cannot be derived from them. Nevertheless, speculating about the consequences these results may have within the context of adolescents' choices, we believe that they coincide with the predictions of the expectations-value model (Ajzen, 1991; Eccles, 1983, 1987, 1989) and with the theories about the influence of gender stereotypes on prejudices towards people who choose careers that do not fit these stereotypes (Eagly & Karau, 2002; Eagly, Wood, & Diekman, 2000). Research on the intention of performing a behavior (choosing a career, in our study) has acknowledged the influence that the opinions of important people -in this case, adolescents' classmates- can have on one's choices. Our results support the existence of differences in attitudes as a function of stimulus' gender and the chosen career. These differences in the attitudes of classmates and of peer groups in general will no doubt affect the intention of choosing the type of career, both in boys and girls.

One of the limitations of our work is that, from the results obtained, we cannot prove a causality relation between these attitudes of adolescents towards people of diverse high school modalities as a function of gender and the differences in their choices of high school modality between girls and boys. Future research should explore more systematically the relation between the way adolescents perceive their classmates' attitudes towards the men and women of various professions and the intention of choosing a specific type of career. However, it would have been of interest to carry out a follow-up study in order to analyze the extent to which to these students finally select careers and domains congruent with their implicit and explicit attitudes.

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