Research Paper 2005/03

Against the tide: gendered prejudice and disadvantage in engineering study from a comparative perspective

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September 2005
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Acknowledgement

Some findings of this research were presented at the American Society for Engineering Education Annual Conference in Utah (Özkale, Küskü and Sağlamer, 2004) and at the 34th Engineering Education Symposium, Design of Education in the 3rd Milenium in Istanbul, 2005 (Özkale, Küskü and Özbilgin, 2005). We gratefully acknowledge the contribution of the conference participants. The authors thank Ahmet Çakmak for his invaluable support in collecting data.
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Abstract

Although a balance has been achieved in overall numbers of female and male students in higher education in the industrialized countries vertical sex segregation has remained high as male academics and students continued to outnumber their female counterparts internationally. Gender representation is only one façade of gendered disadvantage in engineering, as complex forms of gendered disadvantage reside at social, cultural, psychological and economic layers of life, where women engineering students find themselves swimming against the tide of prejudice. Drawing on comparative and historical data, and a qualitative study with interviews and a questionnaire survey, which generated 603 completed responses from female and male engineering students in Turkey; this paper seeks to reveal the complex and layered nature of gendered prejudice levelled at female engineering students. The findings of our study suggest that linear formulations of gendered prejudice and disadvantage in engineering study are insufficient to account for the complexity of influences on career choice and their concomitant gendered outcomes.

Keywords: Career choice, engineering study, gender, prejudice, beliefs, Turkey

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Introduction
Traditionally, research publications on gender and engineering study have drawn a distinction between the supply and demand side of the equation (Cockburn, 1990; Correll, 2004), focusing either on opportunities available for women and men to study science or on how and why women and men choose engineering education and careers. Gendering of the curriculum, its consequences (Hersh, 2000) as well as how gender order is sustained in science (Eisenhart et al., 1998) have also received scholarly attention. However, the geographic imagination of such studies on gender and engineering has remained largely limited to industrial countries (Hersh, 2000). The Turkish case of gender and engineering study is presented in this paper with a view to situate its unique attributes in an internationally comparative context. Drawing on a multifaceted method involving documentary, secondary statistical, qualitative and quantitative data, the paper explores the case of gendered prejudice against women in engineering in Turkey, which is a country that is home to a complex set of paradoxes in terms of women in professional work. Congruent with the approach adopted by Özbilgin, Küskü and Erdoğan (2005), we contend that the gendered beliefs on professional ‘choice’ can be studied through a three-pronged approach involving exploration of the macro-social and structural, meso-institutional and micro-individual influences (see also Layder, 1993 and Bourdieu and Wacquant, 1992). Through analysis of documentary and secondary sources, we trace the interplay of gender and engineering, situating them in their historical and internationally comparative context at the macro level. The meso level analysis involves an overview of the case study organisation and its historical and social legacy for engineering education in Turkey. At the micro level of the self, we explore gendered prejudice through a qualitative study and a quantitative survey of beliefs held by the current cohort of 603 engineering students in a Turkish university. Our findings illustrate that the interlocking influences at these three layers account for gendered disadvantage and prejudice experienced by women and men in engineering study.

Conceptual Framework: Gender and Engineering
Although there were increases in the number of women joining the engineering profession over the last two decades, women engineers are still in a minority in all countries (Hersh, 2000). The number of women involved in engineering in Europe and elsewhere in the world is increasing very slowly (Isaacs, 2001 and Beraud, 2003) i.e. from 5.8 percent in
1988 to 10.6 percent in 1999 in the USA (SWE National, 2001), from 4.6 percent in 1990 to 12 per cent by the year 2010 in the UK (projected by Evetts, 1998). Nevertheless, international data (EUROSTAT, 2004) suggests that women now constitute over 20 per cent of student body in engineering and science subjects across Europe and in the industrialised world.

Although the proportion of female students now exceeds or closely matches that of male students in higher education in industrialized countries, unequal representation has proven unyielding in the field of engineering (EUROSTAT, 2004). Many studies to date have sought to explain the way gender inequalities in engineering have been constructed, focusing on issues ranging from documentation of gender segregation, prejudice and discrimination in the field (e.g. Evetts 1997 and 1998) to offering suggestions to remedy the situation (Davey and Davidson, 1994) and the ways in which gender order is preserved (Leeming and Baruch 1998; Simpson 2000). Many scholars (Van Leuven, 2004; Blattel-Mink, 2002, Isaacs, 2001; Seymour and Hewitt, 1997; Hanson, 1996) pointed out that encouragement from family, friends, teachers, and advisors is pivotal both in choosing and succeeding in engineering education. However, true gender equality, Blattel-Mink (2002) argues, requires both those individual women in scientific subjects should have strong career orientations and that structural, institutional and cultural environs should become more welcoming for women.

What is the reason for the current level of male domination and gendered prejudice against women in engineering? Ismail (2003) argues that women’s success is often contingent upon them adopting an explicitly male pattern of career. Even then, women experience further barriers such as sex discrimination in the workplace. Maskell-Pretz and Hopkins (1997) point towards deep level gendered barriers, rather than male domination, as the main reason for the current situation. Historically the image of engineering has been heavy, dirty and involved machinery (Ismail, 2003). Therefore, by association, both women and men have seen engineering as a masculine profession (Hersh, 2000). Explicit admittance of a belief in gender difference serves as a mechanism to sustain the status quo of the gender order by affirming current inequalities and prejudices as ‘natural difference’, Henwood (1998) argues.

Although there is a decrease in mathematics self-concept for all students in high school, girls' confidence in their mathematics and science abilities declines much earlier than boys’ (Guzzetti and Williams, 1996). The result is that high school girls often
underestimate their mathematics and science competence, feel less adequate, and have lower expectations for success in mathematics and science when compared with boys who are more likely to feel confident in their mathematics and science abilities (Meece and Jones, 1996) and to believe that they are good in mathematics and science even when their school achievements are the same or lower than those of girls (Van Leuvan, 2004). Furthermore, there is extensive evidence that both perception and reality of structural constraints such as sex discrimination and gendered nature of work, rather than women’s free ‘choice’ largely accounts for low participation rates of women in engineering study and profession (Maskell-Pretz and Hopkins, 1997).

Furthermore, Ranson (2003) identifies that ‘common and difficult’ barriers are faced by women engineers who wish to enter this male-dominated field. Schwartz (1992) reveals that some of the best women engineers are opting to leave engineering oriented organizations and set up their own businesses, because they can create the type of environment that is free of such barriers (quoted in Maskell-Pretz and Hopkins, 1997, p.32). Besides learning about these barriers, when girls observe that there are few women in engineering fields, they may conclude that engineering is more appropriate for men than for women (Taber, 1992; Van Leuvan, 2004). Faced with the knowledge of stark and subtle barriers that await women in engineering, girls may opt out of engineering and orient themselves for other fields that promise better chances of educational and career success for them (Hersh, 2000). Although there were exemplary women engineers, such as Lillian Moller Gilbreth (Averett, 2004) who is considered as the co-founder of industrial engineering, gender equality in engineering is still a distant goal. As Bix (2004) concludes ‘at the end of the 20th century, women were still nowhere close to approaching proportional representation in the profession’ (p. 43), let alone achieving inclusive work practices which are welcoming for them.

**Examination of the Turkish Case**

The reasons why Turkey presents a very unique example for gender representation and relations in engineering study and careers are manifold: The common wisdom would suggest that Turkey, a country with a predominantly Muslim population with comparatively low level of education and high unemployment should offer less opportunities for women in the field of engineering study in comparison to other European countries. Turkey presents various challenges to this common wisdom: Although the
proportion of female university students (42.8 per cent) is relatively low compared to other European and industrialized countries, the proportion of women engineers as professionals, academics and students is higher in Turkey than in most of the European and industrialized countries (see EUROSTAT, 2004). Indeed, the proportion of women engineering students in Turkey stands well to international comparison. This is also congruent with better representation of women in professional employment in Turkey across a wide range of fields that are traditionally male dominated in Western Europe and North America (Acar, 1991; Healy, Özbilgin and Aliefendioglu, 2005; Özbilgin and Healy, 2004; Özbilgin and Woodward, 2003; Woodward and Özbilgin, 1998). EUROSTAT (2004) suggests that Turkey houses one of the highest proportions of female students in engineering (34.8 per cent) in Europe after Bulgaria and Portugal, 35.5 and 35.3 per cent respectively. The data also shows that the industrialized countries have lower proportions of female engineering students than developing countries. This provides a contrast to the perception in the industrialized world (Parsons, 1996) of women in engineering in developing countries.

Kahn (1994) situates the origins of women’s accession to the scientific professions in the republican and secular history of the country. The state ideology since the early 1920s upheld penetration of women in technical and engineering professions as a key priority of its modernization and westernization project. Turkish women obtained the right to vote in 1934, before many other European countries. Unlike Western European and North American countries which pursued legal protectionism in order to achieve such results, state ideology was the main driving force behind change, constituting what may be termed as state feminism in Turkey in the last 80 years (Özbilgin and Healy, 2004). This is the basic characteristic distinguishing Turkey also from the Islamic countries.

The centralised, standardised and anonymised university admission system in Turkey offers greater possibilities of gender neutral access to female and male students in comparison to localised approaches adopted in Western Europe and North America (YÖK, 2005).

The university system in Turkey is engineering dominated. 77 Turkish universities have engineering faculties. Every year over 20,000 students start engineering education which is about 15 percent of the total student enrolment in higher education in Turkey. Contrary to the trends of a decline in the popularity of engineering profession in some parts of the world, engineering maintained its popularity (YÖK, 2005) and prestige (Özkale, Küskü and Sağlamer, 2004; Özkale, Küskü and Özbilgin, 2005) in Turkey over the years.
Engineering departments are the main choice of top 2000 highest ranking students in the entrance exam when compared to all other departments. Engineers are also in demand in non-engineering sectors such as banking, finance, insurance, sales, and management primarily due to their strong analytical and numerical skills (see Tantekin-Ersolmaz, Ekinci and Sağlam, 2004).

The Field Studies

Istanbul Technical University (ITU) is the case study institution. Founded in 1773, it is the oldest technical university in the country, with a well-established reputation in offering high quality degrees in engineering (ITU, 2005; Küskü and Levent, 1999; Akduman, Ekinci and Özkale, 2001; Küskü, 2001 and 2003). As an urban state university, offering education to a large number of highly competitive young Turkish women and men, ITU is an interesting sample in which gendered status beliefs of engineering students can be examined.

Data for this study was collected in three stages. After a review of the existing literature, one of the authors of this paper conducted semi structured, in-depth interviews with freshman engineering students attending a course in Management Engineering Department of ITU regarding their beliefs on engineering and gender. More than sixty students were interviewed and the responses were recorded. The co-authors then coded the responses applying axial and open coding strategies. Involvement and broad agreement of three authors in coding of the collected responses suggest a high level of inter rater reliability. The findings from this qualitative stage were content analysed. Drawing on these analyses and the literature review, a questionnaire, including open and closed ended questions, was formed and used in the second stage of the research.

The questionnaire contained three sections. The first part reviewed students’ perceptions of the gender distribution of their department and university. The second part aimed to obtain the reasons of their choice of studying and practicing engineering. The final section was about the socio-economic profile of the students.

In order to reach a large group of students, the questionnaire was administered via the internet, and uploaded to a web address. This address was sent to all the students of the ITU, together with a short explanation about the aim of the research. A reminder was sent one week later.
Generally, studies conducted with students are limited to one or few engineering departments. For example, Baryeh, Squire and Mogotsi (2001) conducted their research with 108 students from two engineering programs. However, in our study, we have sought to achieve a higher level of participation across a wider cross-section of engineering fields. Furthermore, studies on “women in engineering” are generally conducted with female students (Baryeh, Squire and Mogotsi, 2001; Lee, 2002; Van Leuvan, 2004) or women engineers (Koushki, Al-Sanad and Larkin, 1999; Isaacs, 2001; Zengin-Arslan, 2002). However, this paper aims to study the place of women in engineering education in Turkey by questioning the probable difference between the status beliefs of male and female students when they choose the field of study. As men play a larger role in sustaining the gender order which creates gendered disadvantage, we decided to survey the attitudes of both men and women. This paper will contribute to the existing literature by this different approach.

For this second stage of the research, data have been gathered at the beginning of the fall semester 2003-2004. After three weeks of data collection, 399 replies were gathered from the students. Some of them were eliminated due to unanswered sections. The questionnaires, which were filled in by students of other departments than engineering, were also eliminated. Consequently, replies of 386 participants, 75 female and 311 male, were accepted for gathering sample at this stage of the research. Based on these figures approximately six per cent of the engineering students have participated in the study (For more detail, see Özkale, Küskü and Sağlamer, 2004).

The students’ opinions, collected through the interview (first stage) and the pilot research (second stage), were combined with the literature review and informed a set of formal statements on beliefs on gender and engineering. The statements were purposely short, written in simple language, and they addressed a single issue (see Hinkin, 1998). Since all statements in the scale were informed by relevant literature and they have drawn on the interviews with the students, their “content relevance” is considered to be appropriate (Gerbing and Anderson, 1988; Bagozzi, Yi and Philips, 1991). Subsequently a revised questionnaire\(^1\) was formed in order to test the scale, refine the statements, and find the relations mentioned in the theoretical frame.

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\(^1\) The research instrument used in this stage may be obtained from the researchers.
The questionnaire form of this last stage was also constituted of three sections as the previous one. The first section was on students’ affiliations within the engineering department. The second section had 41 statements on the factors that may affect engineering choice. In the last section, general demographic and distributive characteristics as well as various relationships of the students were investigated.

The new questionnaire, which was designed for the third stage of the research, was uploaded to an Internet web page. With a preface, the questionnaire was emailed to all engineering students. The preface aimed to give information about the purpose of the research. The questionnaire was also uploaded to the university web site in order to reach a greater number of students. In the first weeks of the Fall Semester of 2004-2005 (exactly one year after the initial survey) new data were collected. In this period 642 replies were gathered, and after eliminations, 603 completed responses from 133 female and 470 male students were accepted for analysis purposes. The distributive profile of the respondents in the sample closely mirror the distribution of female and male students of the school.

Statements in the scale have been investigated by exploratory factor analysis (EFA). In the classical psychometric scale development studies, it is expected that factor loadings of the statements should be loaded only by one factor with a value higher than 0.60 and also factor loadings should not be lower than the value of 0.40. According to Nunnally (1978), statements that are under the critical value should be deleted from the draft scale for not having contribution to the concept, which we are trying to measure. However, some researchers (Hair et.al, 1998) consider that these values are too flexible and put more conservative limits. Scope of this research does not include a scale development. This is why Nunnally’s idea was preferred, and the analysis was made in this framework. Before applying EFA to the data, KMO sampling adequacy, Bartlett’s test of sphericity and the determinant of correlation matrix are checked to assure that the data is appropriate for the analysis. Facing no problems, we applied principal component EFA, with a varimax rotation and without any restrictions on the number of factors, to the scale. Five statements from the scale were eliminated since they did not satisfy the above-mentioned conditions. This exploratory analysis indicated a ten-dimensional structure for the scale with remaining 36 statements.

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2 [http://160.75.55.86/muhendislik/index2.html](http://160.75.55.86/muhendislik/index2.html)
3 Analyses were carried out using the SPSS (Statistical Packages for Social Sciences) 11.X.
The ten-factor solution for the scale of beliefs on gender and engineering study and profession can explain 64.96% of the total variation in the data. This percentage is satisfactory compared to the solutions in the related literature which do not have that have better explanatory power. Then, the Cronbach-Alpha was calculated to assess scale reliability as it is the most common tool for reliability criterion. According to Nunnally (1978) lower limit of reliability coefficient can be taken as 0.60 for the newly developed scales. Since the values were between 0.8711 and 0.6543, they exceed the lower limit, except for factor 8 (0.5509), the scale can be considered as reliable.

The data related to variables of beliefs on gender and engineering study and profession were analysed using multivariate analysis of variance (MANOVA) in order to understand the role of gender in engineering choice. In this analysis, the categorical independent variable of analysis was "gender" and the dependent variables were the elements in the factors that affect the choice of profession. To understand the underlying contributions of the variables to the significant multivariate effect, we tested each dependent variable using one-way ANOVAs with the two groups. The analysis of MANOVA compensates for variable intercorrelation and provides an omnibus test of any multivariate effect. However, given the large differences in the sizes of the two gender groups (female: 133, male: 470) it was necessary to test for unequal variances among the groups (Hair et al., 1998). Therefore, in all procedures, Box’s M test for homogeneity of dispersion matrices was produced in order to understand the appropriateness of the use of the MANOVA in the analysis. All relations were tested at p < 0.05.

Distributive Attributes of the Respondents
Participants of the questionnaire survey come from a wide range of engineering disciplines. Engineering departments are grouped as 'masculine', 'feminine' and 'mixed sex' based on their gender distribution. Therefore, denoting a department 'feminine' does neither mean that the department is naturally suitable for women nor that women are more likely to choose them (see Zengin-Arslan, 2002). If the department had less than 20 per cent women students, it was classified as 'masculine'\textsuperscript{4}, if it had more than 30 per cent female students

\textsuperscript{4} In this study, Ocean, Electrical, Electronics, Naval Architecture, Marine, Manufacturing, Civil, Geodesy and Photogrammetry, Control, Mechanical, Metallurgical and Materials, Petroleum and Natural Gas, Telecommunication, Astronautical Engineering departments are grouped as 'Masculine' Engineering Departments.
then it is classified ‘feminine’ and the proportions that fall between these categories are termed as ‘mixed’. The gender ratios of participants from each department are proportionate to the population of engineering students in the school. Further, based on ITU registration records, there are 6003 engineering undergraduate students (1497 female and 4506 male). Based on these figures 10 per cent of the students participated in the study. This equates to 8.9 per cent of female and 10.4 per cent of male students.

The levels of study of the respondents mirrored that of the student population. Most of the students have brothers or sisters of whom almost half are currently or have been in higher education study. Parents, relatives and others have a strong influence on career choices of students in Turkey (Özbilgin, Küskü and Erdoğan 2004). Therefore, our study surveyed the distributive attributes of the respondents’ parents. Female students’ parents (both mothers and fathers) are more highly educated than the male students’ parents. This indicates that educated parents are more likely to have daughters in engineering study. Female students are more likely to have working mothers than mothers who are housewives. The opposite applies to male respondents of this study. Teaching appears as the most common form of employment for mothers of the responding students. For fathers, the most common professions are in public sector white collar employment.

The Results

Through the factor analysis, this study has identified ten factors on aspects of belief on key influences on engineering study and gender. From ten factors, the one that has the most explanatory power (9.693%) is formed by five statements. This factor was titled as beliefs on gender and professional choice (see Table 1 for details of statements in this study). The second factor that has 9.150% explanatory power is formed from another five statements and it was titled as beliefs on engineering. Three factors (third, fourth and sixth) are directly related to some aspects of general thoughts on gender in engineering. Therefore

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5 In this case, Environmental, Food, Chemical and Textile Engineering departments are grouped as 'Feminine' Engineering Departments.
6 In this study, Computer, Industrial, Physics, Geophysical, Geological, Mining, Mathematics, Meteorological, Aeronautical, Management Science and Engineering Departments are grouped as 'Mixed Sex' Engineering Departments.
7 You may obtain more detail about distribute attributes of the respondents from the authors.
8 Statements in this factor are “I believe the quality of living as an engineer is much higher than it is in other professions”, “I believe the chances of getting promoted are higher in the field of engineering than in any other field”, “I believe that job opportunities in the field of engineering are more than those in other fields”, “I believe the salary I get as an engineer will be higher than the salaries people get in other professions”, and “I believe I will acquire much more self improvement as an engineer than professionals”.

there are titled as beliefs on women engineers (8.985% explanatory power with four statements), beliefs on women’s interest in engineering (6.605% explanatory power with five statements), beliefs on suitability of engineering fields to women (5.363% explanatory power with four statements). The fifth factor which was related to personal characteristics was named as beliefs on personal aptitude and interest in engineering (5.442% explanatory power with three statements). The seventh contained statements related to family members and it was named as beliefs on influence of close family members9 (5.238% explanatory power with three statements). The eighth factor was titled as beliefs on the influence of the family context10 (4.981% explanatory power with three statements). Since it contained statements about study, the ninth factor was named as beliefs on the influence of education11 (4.802% explanatory power with two statements). The last factor, which has statements of national concern, was named as beliefs on the influence of the national context12 (4.700% explanatory power with two statements).

Following the exploratory factor analysis, we have examined each factor through MANOVA tests. Illustrated in Table 1, the factor on beliefs on gender and professional choice has identified statistically significant differences between the responses of female and male engineering students. All dependent variables related to this factor showed significant differences. Male students in general displayed stronger beliefs on the significance of gender in professional choice than female students. This is important as it suggests that male engineering students assume stronger gender prejudice than female students. Although agreement with the statements in this particular factor is not very high, nevertheless male students appear to hold stronger belief in the interrelationship between professional choice and gender.

9 Statements are “My mother had a great effect on my being an engineer”, “My father had a great effect on my being an engineer” and “My brothers and sisters had a great effect on my being an engineer”.
10 Statements are “I decided to choose this profession because of the way I was brought up”, “I decided to choose this profession because of my gender”, and “I decided to choose this profession because of our financial/economic situation”.
11 Statements are “My high school teachers had a great effect on my being an engineer” and “My teachers at the private course had a great effect on my being an engineer”.
12 Statements are “I believe under the working conditions in our country male engineers get promoted more quickly than the females” and “Due to the working conditions in our country I believe male engineers earn more money than the females”.

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There were no significant differences in beliefs on engineering by gender. Thus both female and male students perceive the profession along the same lines and hold positive views on engineering profession (Mean score for all five statements was 5.108).

The MANOVA test reveals significant differences between female and male engineering students in their beliefs on women engineers (Table 1). While women engineering students have responded positively to the idea that there are successful women engineers and that engineering is a suitable career for women, male students have reported much lower support for these positive statements.

As illustrated in Table 1, in the factor titled beliefs on women’s interest in engineering, the respondents were in broad agreement with the statement that the low interest in the field was due to absence of proper guidance from their families and schools. Female students reported lower degree of support than their male peers to the statements which suggested that women are innately disinterested in engineering. Male students consider aptitude and interests of women, rather than structural conditions, as reasons for lower representation of women in the field.

Another indication that there is no difference in personal identification of the female and male respondents with engineering is illustrated in Table 1 (see the factor titled beliefs on personal aptitude and interest in engineering). Both female and male students rated their interest in the science subjects associated with engineering as well as their talents and aptitude to be of positively relevant in their choice of engineering as a profession. However, male students displayed a stronger belief in their innate ability to the subject of engineering than their female peers.

As demonstrated in Table 1, the female students reported stronger support for the statement that “rather than innate factors, lack of opportunities is considered more strongly by male students, for affecting women’s suitability for the engineering profession.

Multivariate MANOVA test on the factor, beliefs on the influence of close family members, has not identified any significant difference between the responses of female and male respondents. However, in general the students have reported very low support for the influence of their parents and siblings (the total mean score was 2.45). Such was the case for the belief in influence of family background and context on choice of engineering (The total mean score was 2.45). Similarly, the students of both genders reported very low agreement with the statements that they have chosen engineering due to their personal circumstances. Both male and female students broadly agreed with the statement that male
engineers enjoy better opportunities for career advancement in the country in comparison to their female counterparts (The total mean score was 4.26). There was less support by both groups of students regarding male engineers being paid better than female engineers (The total mean score was 3.75). Multivariate MANOVA tests do not identify any gender differences for the support of the statements on the influence of close family members, education and national context on career choice\textsuperscript{13}.

Discussion and Conclusions

Examining the curious case of Turkish engineering students, our study on gendered prejudice in engineering study revealed that proportionate representation of women in engineering is only a necessary but not a sufficient condition for elimination of gendered disadvantage and prejudice. The Turkish case presents a challenge to the critical mass hypothesis (Dahlerup, 1988) which suggests that as the proportion of women reach a critical mass in workplaces; this will engender a further egalitarian change, helping to eradicate gendered prejudice. The Turkish case is unique as the existence of a critical mass of female students in engineering has not altered the taste for gendered prejudice in engineering study. Analysis of our findings unambiguously demonstrates that numerical representation alone does not ensure sufficient protection against gendered prejudice. Nevertheless numerical representation has a moderating impact on the gendered disadvantage and prejudice that female students may experience. Demonstrably female and male students in ‘mixed sex’ departments in Turkey reported lower levels of gendered prejudice regarding women in engineering, than their counterparts from departments which are male or female dominated.

There are two interesting findings of gender neutrality and difference in our study. On the one hand, there is neutrality in beliefs of female and male students in the value of engineering as well as their personal attachment and interest to the subject. On the other hand, female and male students hold different beliefs regarding the impact of gender and professional choice. Compared to female students male students more strongly believe that there is link between gender and professional choice and that there are innate gendered attributes that make men more and women less suitable for engineering study. Male students also hold weaker beliefs in the value of women engineers than female students. Although, the professional identity and attachment of female and male students were

\textsuperscript{13} Related data on these factors may be obtained from the authors
similar, male students displayed stronger gendered prejudice regarding women in engineering.

Another form of gendered prejudice was evident in male students’ responses about women’s interest in engineering. Whilst male students ascribed the lack of interest to innate factors, female students pointed the contextual factors such as the conditions of employment in order to explain the lack of female interest in the subject. The belief that male students display tacitly suggests that absence of women and female interest in engineering fields is a matter of choice rather than an outcome of structural conditions. Women engineering students are more likely to have educated parents with urban backgrounds and professional standing; it can be argued that women’s interest alone cannot account for their representation or interest in engineering on their own.

Both female and male students had very weak belief in the influence of family on choice of engineering. This result is congruent with the findings of Özkale and Küçükçifçi (1999). This is an interesting finding for a country where parental influence is comparatively more significant on career choices of individuals (Özbilgin, Küskü and Erdoğan, 2005). Nevertheless, our study suggests that both female and male students report parental support at the same level.

The efforts in Turkey to combat gender equality in science and engineering have been driven by Turkey’s longstanding modernization project, through an ideological agenda, which can be termed as state feminism, which operated under the founding principles of republicanism and secularism in the country. However, the ideological impetus for equality has been deteriorating as neo-liberal logics are invited into management of universities and the labour relations in the country. Western European and the North American experience suggests that in the absence of such national or political drives for redressing gender balance, local and regional efforts that seek to tackle gendered disadvantage may yield positive outcomes. Weiger (2000) describes the use of out-reach activities, where universities reach out to the secondary schools with a view to train and inform minority students in order to encourage them to take up engineering and science subjects. Such initiatives may prove useful in a country such as Turkey, where there is a tradition of using female role models to encourage women in professional work. However, this new approach shifts the responsibility to monitor and combat gender segregation and prejudice from the state towards the institutions of higher education.
Each year over 1.7 million students in Turkey take a standardized university entrance exam on the same day. The exam papers are anonymized with a registration number and the university entrance solely relies on the scores achieved as well as the choices made. The system does neither allow for interview bias nor informal relationships to inform university entrance and it offers greater level of transparency, and thus equal opportunity for access to privileged fields of study such as engineering, and medicine in Turkey. A gender bias remains in the choice of subjects that female and male school graduates identify as their primary choice of study at the university in Turkey (YÖK, 2005). However, the level of horizontal segregation remains low in comparison to other countries (see EUROSTAT, 2004). Further, even the standardized systems display gendered outcomes due to the differentiated expectations of female and male students (Correll 2004). Indeed it is well established that there are gendered patterns in the choice of subjects and options during the school years, with large numbers of studies indicating that, in general, girls are less likely to select the physical sciences and more likely to select languages (Makrakis and Sawada, 1986; Lightbody and Durndell, 1996; Siann and Callaghan, 2001). For example in our study, both male and female students broadly agreed with the statement that ‘male engineers enjoy better opportunities for career advancement in the country in comparison to their female counterparts’. Armed with this belief, it is likely to expect women to shy away from engineering in favour of feminised disciplines. Nevertheless the transparent system of admissions is instrumental in overcoming one set of potential gender biases at the outset.

Although the male and female students shared similar ideals with regards to engineering as a profession, our study has identified that male students hold stronger gendered prejudices regarding suitability of engineering for women. Despite favourable representation of women in engineering study, and the long-standing tradition of women in engineering profession, women students continue to experience gendered prejudice. Therefore, our findings are in line with Kahn’s (2004) argument that the comparatively high representation of women in scientific careers in Turkish academia is paradoxically coupled with deeply steeped beliefs that tacitly condemn women to traditional roles.

When compared to the legal protectionism that Western European and North American countries have pursued in combating gendered disadvantage in social and educational spheres, the ideological route that Turkey has taken appears to have engendered access for a higher proportion of women to engineering study and careers. Yet, what
remains to be tackled is the lived experience of gendered prejudice, manifesting itself as ‘gendered status beliefs’ (Ridgeway, 1991). Whilst gendered status beliefs appear at the level of the individual, the complex set of factors such as the historical legacy of gendered relations in engineering, the specific institutional context, along with interpersonal and relational concerns come into play. Therefore a redress for the gendered status beliefs that our study has identified requires, legal and ideological support at the level of state policy and regulation, an institutional commitment to understand and tackle gendered prejudice and interpersonal measures such as building of networks between female students, identification and use of mentors and more importantly a strong personal awareness that can equip the female students with the resolve, view and vision to counteract the entrenched forms of gendered prejudice that manifest itself through their lived experience.

It is important to acknowledge that both female and male students hold positive views on engineering profession. This is congruent with the social image of the profession in Turkey. The gendered prejudice was more prevalent in male dominated departments. However, women engineering students also displayed, although to a lesser extent, gendered prejudice towards women in engineering profession. Set against the macro-societal and structural as well as meso-institutional factors that appear as favourable towards women’s inclusion in engineering study and profession in Turkey, micro-individual level gendered prejudice against women in engineering continues to present itself as a tide against which female students continue to swim.

Current research and activism for women in engineering, focuses on gender representation and how a balanced representation can be achieved. Our findings suggest that gender representation is only one dimension of gendered disadvantage in engineering, as complex forms of gendered disadvantage reside at social, cultural, psychological and economic layers of life. Therefore tackling disadvantage in engineering should involve multilayered and multidimensional programs that tackle disadvantage in domains as wide as social life, schooling and education, work and organization. Siann and Callaghan (2001) state that considerable resources have been devoted internationally to intervening in gendered patterns of study, with a particular emphasis on increasing both the numbers of girls opting for science and engineering courses and their levels of enjoyment of engineering study. However, these interventions have been predicated on a ‘barrier’ paradigm, seeking combating strategies (UNESCO, 2005). Supplementing the combating strategies associated with the barrier paradigm, literature offers some alternative positive
support strategies, such as enforcing positive behaviours and attitudes (Sonnert and Holton, 1995), as well as advancing women’s negotiation and self-promotion skills (see Babcock and Laschever, 2003).

One of the key issues in terms of women’s participation in the labor force in Turkey has been the unplanned nature of the internal migration that Turkey has experienced since the 1950s, where there was a mass migration from rural areas to large cities. The literature on migration suggests that migration has a disproportionately negative impact on women, resulting in their de-skilling. Furthermore, families in the rural areas have stronger belief in differentiated gender roles and hence in terms of the role of women in society (Özbilgin and Woodward, 2003). Our findings indirectly confirm this as women respondents are more likely than male respondents to have families from large cities, indicating that families from rural areas and smaller towns are less likely to encourage their daughters to take up engineering study and career.

Finally, in the context of projected increase in the upsurge of demand and shortage of supply for engineers (Layne, 2001), countries where the supply and demand gap exists will need to draw on non-traditional segments of society to provide their next generation of engineers. This means that countries and institutions that understand the value of diversity and act to eliminate discriminatory practices in order to make engineering profession and study welcoming for a wider spectrum of women and men will benefit in the longer term. Our findings suggest that there is not a linear development in terms of women’s accession into engineering study and profession, as gendered prejudice and the structural constraints and opportunities are in constant state of change. The hope remains that the Turkish women should win the battle against new forms of gendered prejudice, replicating their earlier success in gaining access to the engineering profession and study in large numbers. However, in the absence of institutional and national mechanisms in place to tackle with the gendered prejudice manifesting as gendered status beliefs in schooling, social life and professional careers, the hope is unlikely to materialize.

Furthermore, there is scope for mentorship. It has been argued (Siann and Callaghan, 2001; Van Leuvan, 2004) that women choose opt out of science and engineering courses due to lack of role models and female networks in science and engineering education and professions. Therefore the perceptual shortage of role models and mentors, if left unaddressed, may also lead the perception to become a self-fulfilling prophecy.
The implication of our findings for the industrialized countries is that greater access of women into the engineering profession and education will result in a partial success, unless it is supplemented with strategies to transform gendered cultures that feed gendered status beliefs and prejudice. The problem of gendered prejudice is more complex in nature than that of male domination in numbers and it cannot be addressed by simplistic and linear formulations of anti-discriminatory action, as it requires a kind of social change that can only be possible if gendered prejudice is recognized as a serious accomplice in shaping of gendered disadvantage and through systematic action involving a multiparty engagement at macro-social, meso-institutional and micro-individual levels.
References


ITU (2005), http://www.itu.edu.tr/el/gb-5.d4


Ranson, G. (2003), Beyond ‘Gender Differences’; A Canadian Study of Women’s and Men’s Careers in Engineering, Gender, Work and Organization, 10, 1, 22-41.


Table 1: Beliefs on gender and engineering study and profession

<table>
<thead>
<tr>
<th>Statements</th>
<th>Female (n=133)</th>
<th>Male (n=470)</th>
<th>Total (n=603)</th>
<th>Std. Deviation (for total)</th>
<th>F (Sig.)^b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beliefs on gender and professional choice</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The overall Wilks' Lambda multivariate test was significant at F= 5.339, p=0.000</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>A person's gender is important in choosing a profession as certain professions require certain physical capabilities.</td>
<td>4.03</td>
<td>4.82</td>
<td>4.64</td>
<td>1.93</td>
<td>17.633 (.000)</td>
</tr>
<tr>
<td>A person's gender is important in choosing a profession because of the working conditions in certain professions.</td>
<td>4.29</td>
<td>5.12</td>
<td>4.94</td>
<td>1.89</td>
<td>20.462 (.000)</td>
</tr>
<tr>
<td>In my opinion a person's gender is important in choosing a profession.</td>
<td>3.14</td>
<td>3.98</td>
<td>3.80</td>
<td>2.06</td>
<td>17.591 (.000)</td>
</tr>
<tr>
<td>A person's gender is important in choosing a profession because of socio-cultural expectations.</td>
<td>3.17</td>
<td>3.66</td>
<td>3.55</td>
<td>2.01</td>
<td>6.072 (.014)</td>
</tr>
<tr>
<td>A person's gender is important in choosing a profession as males and females have different interest areas.</td>
<td>3.49</td>
<td>4.22</td>
<td>4.06</td>
<td>2.00</td>
<td>14.269 (.000)</td>
</tr>
<tr>
<td>Beliefs on women engineers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The overall Wilks' Lambda multivariate test was significant at F= 25.129, p=0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are many very successful female engineers.</td>
<td>6.14</td>
<td>4.84</td>
<td>5.13</td>
<td>1.89</td>
<td>53.551 (.000)</td>
</tr>
<tr>
<td>I believe females can generally be very successful in engineering.</td>
<td>6.14</td>
<td>4.59</td>
<td>4.93</td>
<td>1.89</td>
<td>78.071 (.000)</td>
</tr>
<tr>
<td>There are many very successful female engineers in our country.</td>
<td>5.77</td>
<td>4.47</td>
<td>4.76</td>
<td>1.89</td>
<td>54.019 (.000)</td>
</tr>
<tr>
<td>I believe engineering is generally a suitable job for females.</td>
<td>5.78</td>
<td>4.18</td>
<td>4.54</td>
<td>1.94</td>
<td>79.608 (.000)</td>
</tr>
<tr>
<td>Beliefs on women's interest in engineering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The overall Wilks' Lambda multivariate test was significant at F= 10.526, p=0.000</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Female students are not interested in the fields of engineering as they are not guided sufficiently during high school education.</td>
<td>4.07</td>
<td>4.31</td>
<td>4.26</td>
<td>1.82</td>
<td>1.914 (.167)</td>
</tr>
<tr>
<td>Female students are not interested in the fields of engineering as they are not guided sufficiently by their families</td>
<td>4.15</td>
<td>4.47</td>
<td>4.40</td>
<td>1.77</td>
<td>3.435 (.064)</td>
</tr>
<tr>
<td>The lowly proportionate representation of successful female engineers prevents women from choosing engineering as a profession.</td>
<td>3.28</td>
<td>4.10</td>
<td>3.92</td>
<td>1.97</td>
<td>18.374 (.000)</td>
</tr>
<tr>
<td>Females are generally less interested in engineering.</td>
<td>4.05</td>
<td>5.11</td>
<td>4.87</td>
<td>1.71</td>
<td>43.138 (.000)</td>
</tr>
<tr>
<td>Female students are not interested in the fields of engineering as these fields do not match with their interests.</td>
<td>3.89</td>
<td>4.63</td>
<td>4.47</td>
<td>1.68</td>
<td>20.810 (.000)</td>
</tr>
<tr>
<td>Beliefs on personal aptitude and interest in engineering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The overall Wilks' Lambda multivariate test was significant at F= 16.555, p=0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I've been interested in studying engineering since childhood.</td>
<td>4.62</td>
<td>5.48</td>
<td>5.29</td>
<td>1.81</td>
<td>24.349 (.000)</td>
</tr>
<tr>
<td>I wanted to be an engineer because of my interest in such subjects as maths, physics, and chemistry.</td>
<td>5.75</td>
<td>5.48</td>
<td>5.54</td>
<td>1.69</td>
<td>2.661 (.103)</td>
</tr>
<tr>
<td>I decided to choose this profession because of my abilities and talents.</td>
<td>4.87</td>
<td>4.93</td>
<td>4.92</td>
<td>1.99</td>
<td>.093 (.760)</td>
</tr>
<tr>
<td>Beliefs on suitability of engineering fields to women</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The overall Wilks' Lambda multivariate test was significant at F= 18.690, p=0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female students are not interested in the fields of engineering as the job opportunities are limited in this profession.</td>
<td>2.95</td>
<td>2.81</td>
<td>2.85</td>
<td>1.76</td>
<td>.656 (.418)</td>
</tr>
<tr>
<td>I think that under the working conditions in our country it is difficult to work as a female engineer</td>
<td>3.10</td>
<td>3.90</td>
<td>3.72</td>
<td>1.95</td>
<td>17.997 (.000)</td>
</tr>
<tr>
<td>I believe under the working conditions in our country female engineers haven’t got enough chance to work as an engineer</td>
<td>4.33</td>
<td>3.89</td>
<td>3.99</td>
<td>1.93</td>
<td>5.386 (.021)</td>
</tr>
<tr>
<td>Female students are not interested in the fields of engineering as their physical capabilities do not fit to this profession.</td>
<td>2.71</td>
<td>3.80</td>
<td>3.56</td>
<td>1.85</td>
<td>38.246 (.000)</td>
</tr>
</tbody>
</table>

^a All statements were measured by a 1-7 strongly disagree-strongly agree Likert scale and the mean indicates the selected frequency by each group for the acceptance of the statements (variables).

^b Significance level
ESRC research papers

2005/01 Öner Güncavdi, Suat Küçükçifçi ve Murat Üngör, “Cari Açıklar ve Türkiye Ekonomisinin Artan Döviz İhtiyacı”.

2005/02 Fatma Küskü and Berk Ataman, "Employment Interview Satisfaction of Applicants within the Developing Context”

2005/03 Fatma Küskü, Mustafa Özbilgin and Lerzan Özkale, "Against the tide: gendered prejudice and disadvantage in engineering study from a comparative perspective".