

Electricity in the Palms of Her Hands - The Perception of Electrical Engineering by Outstanding Female High School Pupils

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Abstract: This article explores how outstanding female high school pupils perceived the profession of electrical engineering (EE) before and after a one-day conference aimed at exposing them to the profession of EE. The main finding indicates that, if planned properly and thoughtfully, even a single one-day conference can significantly change the perception of what EE is. In addition, we explore the pros and cons of studying EE, as were expressed by the female high school pupils. We conclude with some recommendations related to the role of women in EE.

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1. Introduction

Gender issues have been recently discussed with respect to fields such as computer science and software engineering (cf. *Inroads* special issue on women and computing, Camp, 2002) as well as information technology (cf. *IEEE Technology and Society Magazine* special issue on women and minorities in information technology, Varma 2003). The present article aims to broaden the discussion to include the field of electrical engineering (EE), in which the under-representation of women is even more salient than in the other above-mentioned fields. This under-representation is referred to as part of “the incredible

shrinking pipeline” phenomenon (Camp, 1997), which examines academic computing and EE programs. It was found that the "shrinking pipeline" phenomenon is predominant not only in the US, but in other countries as well, such as Canada, Australia, Netherlands, and Israel, which is the focus of this article. Thus, for example, the percentage of female undergraduate students in the Department of Electrical Engineering at the Technion – Israel Institute of Technology (IIT), Israel's leading school of engineering, was less than 15% in both 2002 and 2003.

Although there are no easy solutions to the complex problem of attracting women and minorities to the field of EE, a partial solution might be to increase the awareness of female high school pupils, first, to the very existence of the field of EE and second, to its nature. This article reports on an exposure day, entitled “Electricity in the Palms of Her Hands”, that was planned specifically for female high school pupils who excel in mathematics (henceforth referred to as 'the pupils'). This exposure day, the title of which follows the words of a popular Hebrew song, addressed the image of EE, as well as the image of the professionals working in the field, in an in-depth manner.

The article describes a study that examines the perception of EE as expressed by 124 pupils. These perceptions are presented in Section 4, with a focus on three main observations. First, we discuss the change in the pupils' perception of the profession of EE. More specifically, it was found that while on the morning of the exposure day the pupils perceived EE to be a technical field, by the end of the day the pupils were talking more about its multi-faceted nature. Second, it is shown how the very existence of such an exposure day can influence the perception of EE as a profession that the pupil might consider studying. Finally, arguments and considerations expressed by the pupils in favor and against studying EE are discussed.

2. Gender and the Technion's Department of Electrical Engineering

2.1. The Department of Electrical Engineering at the Technion¹

The Department of Electrical Engineering at the Technion is ranked among the top ten electrical engineering and computer science departments in the world. It is the largest of the Technion's departments, with 1,800 undergraduate students in four main programs (electrical engineering, computer engineering, computer and software engineering and

¹ For additional details, visit the department's website: <http://www.ee.technion.ac.il/>.

electrical engineering and physics), and over 400 graduate students. The department acts as a center of excellence in applied and theoretical research, contributing to the advancement of knowledge in electrical and computer engineering in Israel and throughout the world. The department maintains extensive relations with the industry, as well as several special academic and industrial liaison support programs. Many former graduate students hold leading positions in the Israeli hi-tech industries.

Research at the department is varied and broad in scope and includes, among other topics, computer communication networks, very large scale integration (VLSI), signal processing, image processing and computer vision, electromagnetic engineering, electronic and microelectronic devices, solid-state electronics, electro-optics and opto-electronic systems, and biological signals and systems. By providing a very wide and basic scientific background, strictly selecting its candidates, and maintaining a high level of academic studies, the department enables the absorption of rapidly changing knowledge. Thus, graduates are able not only to cope with current engineering problems, but are also equipped to face future challenges.

2.2. Women at the Technion's Department of Electrical Engineering

The percentage of women studying EE at the Technion is relatively low. In 2002, only 12.3% of the department's undergraduates were women, and that ratio increased only slightly in 2003, to 13%. Of the other seventeen departments at the Technion, only one has a lower representation of women: the Department of Mechanical Engineering (with only 9.7% women in 2002, and 11% in 2003). The percentage of women faculty members in the Department of EE is even lower: only 4 of the 50 faculty members are women (8%).

At the same time, achievements of the female EE students are, on average, high. According to Professor Baruch Fischer, former dean of the department (1999-2003), women are equally capable of succeeding in EE studies as are men. "The low representation of women in the department results from the low awareness of what the department offers and what its research areas are, as well as the unjustified 'masculine' image of the profession of electrical engineering", said Prof. Fisher (the *Technion Magazine*, Winter 2004).

Three years ago, an attempt was made to increase the representation of women in the Department of Electrical Engineering's undergraduate programs. The department

decided to expose female high school pupils to the richness and variety of subjects currently studied at the department, to its distinguished research laboratories, to career opportunities in EE, and to pros and cons of being a female electrical engineer. Following that decision, an exposure day was planned, entitled “Electricity in the Palms of Her Hands”. During the past three years, about three hundred female high school pupils, from an array of Israeli high schools, visited the department of EE in the framework of three separate exposure days, during which they heard lectures, saw demonstrations, visited laboratories, and met with female graduate and undergraduate female students of the department. This paper focuses on the largest and most recent exposure day, that was held on December 31st, 2003, and which was attended by 124 female pupils from seventeen Israeli high schools.

2.3. The December 2003 Exposure Day

On the morning of December 31st, 2003, the newly-built lobby of the Technion's Department of Electrical Engineering, through which students usually pass on their way to laboratories or lectures, was crowded with several groups of unusual visitors. Not only were these visitors younger than the regular students, but the female-to-male ratio in these groups ($=1.0$) was drastically different than the regular ratio in the department (<0.15). The young visitors each held an elegant folder containing information about the Department of EE, and wore colored nametags. Some of them also wore T-shirts designed especially for the event, with the caption “Electricity in the Palms of Her Hands” printed on the back and gladly accepted the photographer's offer to take their pictures, as they awaited the formal opening of the special event.

When invited to enter the auditorium and take a seat, each visitor was handed a yellow form on which she was requested to anonymously answer several short questions about her perception of EE and her future plans for higher education. After several minutes, during which the pupils filled out the questionnaire, Dr. Ayellet Tal formally opened the event. Dr. Tal, the third author of this paper, is a faculty member of the Department of EE and leader of the exposure days organizing committee. In her talk, Dr. Tal briefly reviewed some of her current research issues in the area of computer graphics. It was decided to start the day with Dr. Tal's presentation in order to expose the pupils, from the very beginning, to a female role model (Cphoon, 2002; Townsend, 2002). After the Dean's Greetings,

which followed, Revital Barzilai, a female undergraduate student described her experiences at the Department of EE. She especially addressed the difficult early days at the department, as well as her present feelings of experiencing “challenging but fascinating studies” and of enjoyable social and cultural life.

The pupils then listened to a plenary talk, given by Dr. Avinoam Kolodni, on the connections between science, technology and society. Cultural evolution was described in terms of technological devices, such as cellular phones, music and the everyday use of the Internet, with which the pupils are familiar. After commenting that while technology changes very fast, social conventions do not follow that rate of change, Dr. Kolodni asked his audience “How many of you have a father who is an engineer?” Half of the audience raised their hands. When the question referred to an engineer mother, only twenty students raised their hands (~15%). This short vote very clearly illustrated the need for social change. Later on, Dr. Kolodni asked his audience what electrical engineering is – a question already addressed by the pupils individually when filling out the yellow form. His guess that “You probably imagine a worker with a hardhat, standing on the top of an electric pole” was accompanied by a ripple of laughter from the audience. As will be shown later (in Section 4), this guess was not too far from the way in which this audience indeed perceived EE at that specific time.

The plenary session set the stage needed to increase the pupils' awareness to the facts that (1) women can succeed as electrical engineers and that (2) women are still under-represented in the field of EE. The exposure day then proceeded with two sessions of parallel activities conducted in small groups. (See Table 1 for the full agenda). During the first session, groups of about twenty pupils each visited several of the department's laboratories (the Microelectronics Lab, SIPL - Signal and Image Processing Laboratory and CRL - the Control and Robotics Laboratory), and saw demonstrations and experiments presented by faculty members and graduate students. Each group was accompanied by a undergraduate student from the department (male or female), who served both as a “tour guide” and as someone with whom the pupils could talk informally about student life in the department. The parallel sessions were planned so that each high school pupil visited laboratories, heard talks, and saw experiments related to topics that are close to her own fields of interest.

During the second session of parallel activities, after a lunch break, each group of female high school pupils met a female alumna of the department of EE. These women

alumni represented a wide range of areas in which an electrical engineer can develop a career following graduation. The objective of the meetings was to increase the pupils' familiarity with the actual work of electrical engineers in general, and to expose them to the personal story of one female electrical engineer in particular.

Table 1: Exposure Day Agenda²

Hour	Topic
9:00-9:30	<p>Opening:</p> <p>Dr. Ayellet Tal - An EE faculty member, described her research on computer graphics.</p> <p>Professor Baruch Fischer, Dean, words of greeting.</p> <p>Revital Barzilai - An undergraduate student, described her social and academic life in the department.</p>
9:30-10:00	<p>Plenary talk:</p> <p>Dr. Avinoam Kolodni - Engineering and Society. The talk concluded, first, that engineering may serve as a lever for economic and social development and second, that it is a challenging and interesting way of thinking.</p>
10:00-12:00	Parallel activities: Demonstrations and visits to the department's laboratories.
12:00-12:30	Lunch break.
12:30-13:30	A tour of the Technion campus.
13:30-14:15	Parallel activities: Meetings with female alumni of the department.
14:15-14:30	Closing session

The main ideas emphasized throughout the exposure day were:

- **The interdisciplinary, multi-faceted nature of the profession of EE and the variety of topics that it encompasses:** In order to change the vague public image of EE, the exposure day dealt with a variety of topics (micro-electronics, artificial intelligence, image processing, connections to biology, etc.).
- **The close relationship between EE and society and real-life applications:** Research reveals that “women, to a somewhat greater extent than men, are apt to choose fields of study they believe will contribute to the social good, and engineering and related sciences are not widely perceived as professions making such contributions” (Muller 2003, p. 121). Accordingly, women might not choose an EE career if their perception

² Visit the exposure day's website: <http://www.ee.technion.ac.il/GDay/GDay-311203/index.html>

of the field does not include social aspects. For this reason, the exposure day emphasized applications and products developed by electrical engineers, which directly affect everyday life, culture and art, such as state-of-the-art technologies for picture and music processing.

- **Women's representation:** The percentage of women who played an active role in the conference was high relative to their over all representation in the department. In addition, those women were from different backgrounds and held various degrees: faculty members, graduate students, undergraduate students and alumni. It is reasonable to assume that this close interaction with female electrical engineers from different backgrounds has the potential to influence the pupils' perception of the professional life of electrical engineers.
- **Students' cultural and social life:** Although learning and professional development are the main goals of students who choose to study at the Department of EE, the cultural, social, and communal aspects of student life cannot be ignored, since they may influence the pupils' future choice whether or not to study in a specific department. In order to illustrate some of the social aspects of life in the Department of EE, the exposure day was held on the same day of the week on which the students' arts and crafts fair takes place. As can be seen in Table 1, the conference schedule included a tour of the Technion, free time to visit the fair, listen to the music, taste the Technion atmosphere, and talk with current students.

3. Study Framework

Our study was guided by two main objectives. First, we wished to reveal the pupils' perception of EE. Second, we wished to track changes that took place in that perception over the course of the exposure day. In order to accomplish these goals we used open questionnaires as well as ethnographic observations.

Morning Questionnaire: The first questionnaire, filled out by all 124 attending pupils, was distributed in the morning, before the beginning of the opening session. It focused both on the pupils' preferences regarding the possibility of future study at different Technion departments (including EE) and on their current perception of EE. A translation of the morning questionnaire is presented in Appendix 1.

Afternoon Questionnaire: The end-of-the-day questionnaire was distributed during the closing session of the day. It was filled out by 45 of the pupils who stayed until the end of the day (the other pupils either left earlier or were too tired by the end of the day to fill it out). This questionnaire examined the pupils' perceptions of the profession of EE and attitudes toward the field, as were reconstructed throughout the day. An additional objective was to receive feedback on the exposure day. Translation of the end-of-the-day questionnaire is presented in Appendix 2.

Ethnographic Observations: The first two authors served as participant observers and documented the day using field notes. We participated in all of the activities, accompanied visits to the laboratories, and attended meetings with the alumni. The resultant field notes served as an additional source of data from which it was possible to learn more about the pupils' perceptions of EE at the beginning of the day, throughout the day, and at the end of the day. These field notes also provided us with supplementary background data on social, cultural and gender issues that arose during the day.

Inductive analysis was used to analyze the qualitative data (Maykut & Morehouse, 1994). The categories presented below, which describe the pupils' perception of EE, emerged mainly from carefully reading the pupils' written responses and from a close examination of the answers' relevance to our research objectives.

4. Results: What is Electrical Engineering? Should I Study Electrical Engineering? Why?

From a comparison of the pupils' written responses given at the end of the day with those given in the morning, it is clear that a change took place during the day and that the pupils reconstructed their perception of EE. The following three observations explain the nature of this change. The first observation analyzes the actual change in perception. The second observation illustrates how the very existence of such an exposure day was sufficient to reduce the pupils' resistance toward studying EE. The third observation explores the pros and cons presented by the pupils with respect to the possibility of studying at the Technion's Department of EE.

Observation 1: Change of perception

This observation explores the change in the pupils' perception of the profession of EE during the exposure day. As is illustrated in what follows, while the pupils' pre-conception of the profession of EE indicated ignorance and a lack of awareness to what EE is, the end-of-the-day perception was focused and addressed the multi-facet nature of the field. We suggest that this was not merely a transformation from an *I-do-not-know* situation to an *I-do-know* situation; rather, we propose that the change encompasses both a different *perspective* on the profession of EE, as well as a different *perception* of the profession.

Before elaborating on this change, we wish to explain the wording of the questions on which this analysis is based. The relevant question on the morning questionnaire (Question 5: "What do you think EE graduates do when they graduate from the Technion?") was worded in an operative form, since we assumed that, at that time, the pupils might find it easier to describe actual activities that electrical engineers perform. At the end of the day, reference was made both to the abstract and to the operative aspects of EE (Question 2: "What would you say if you were asked to explain what EE is in two sentences?" and Question 3: "List at least three things that electrical engineers do when they graduate from the Technion"). Pupils' answers to these two questions complemented each other since Question 2 addressed EE as a body of knowledge, while Question 3 once again examined pupils' perception of the activities that professionals in the field of EE perform. This dual perspective actually highlighted different aspects of the perception changing process.

Tables 2 and 3 summarize the change of perception. As Table 2 indicates, only one third of the pupils expressed *any* meaningful perception of EE in the morning, whereas the other two thirds had either no meaningful answer to give or gave answers that reflected ignorance and lack of awareness. In contrast, when asked again at the end of the day, most of the pupils' answers indicated that during the day they had constructed an academic, engineering, scientific and human-related image of the profession. Furthermore, at the end of the day, terms that indicate a multi-facet perception of EE were used to describe the profession of EE (e.g., "variety", "combination", "broad", "no limits").

Table 2: Perception of EE before and after the exposure day

	Morning	Afternoon
Question	No. 5: What do you think EE graduates do when they graduate from the Technion?	No. 2: What would you say if you were asked to explain what EE is in two sentences?
Total number of answers	120	45
Number of meaningful answers (%)	44 (36%)	40 (89%)
Elaboration on the meaningful answers	Only two answers addressed the multi-faceted nature of EE, e.g., "A combination of several branches that are involved in the invention of instruments in different domains (such as medicine)".	21 answers (50%) described EE as a multi-faceted field, e.g., "A huge variety of similar, as well as different, domains that are connected to the society, economy, industry, and to our life in general."
	7 pupils mentioned computers.	18 pupils mentioned computers.
	18 pupils presented the profession of EE as a technical profession, addressing tools and instruments .	3 pupils indicated tools and instruments .
	4 of the above 18 pupils indicated the electricity company, e.g., "They go to work in companies like the electricity company.", "Maybe they go and work as technicians in areas that are related to electricity, etc."	4 pupils specifically indicated that EE is <i>not</i> the electricity company, e.g., "Now I know that it does not mean only working in the electricity company".
	None of the pupils indicated any connection to society or to any other social issues .	5 pupils indicated social issues , e.g., "A kind of engineering that is manifested in electrical products and contributes to the quality of life."
Number of non-meaningful answers (%)	76 (64%)	5 (11%)
Examples of meaningless answers	"Engineering electricity", "Look for a job in companies in which electrical engineering can work".	"I don't know", "I can't explain it in two sentences" ³ .

³ This answer might also be interpreted as a reflection of the idea that EE is too rich to be described in two sentences.

More specifically, as can be seen from Table 2, the pupils' perception of EE underwent transformation over the course of the day, with respect to three categories. First, the **multi-faceted nature** of the field, barely mentioned in the morning, was mentioned frequently in the pupils' answers at the end of the day. Second, the **technical** (instrumental) aspect, which was so prominent in the morning, all but disappeared throughout the day. Third, the **social** aspect, which was not mentioned at all in the morning, emerged at the end of the day. The emergence of the last category is important since, as mentioned earlier, women tend to choose human-related professions.

Table 3, which addresses typical **activities** associated by the pupils to electrical engineers, adds another dimension to this process of perception changing. More specifically, while in the morning pupils' descriptions tended to be vague and general, much more specific and concrete descriptions were exhibited at the end of the day⁴.

**Table 3: Activities performed by electrical engineers
- Pupils' perception before and after the exposure day**

	Morning	Afternoon
Question	Question 5: What do you think EE graduates do when they graduate from the Technion?	Question 3: List at least three things that people who work in EE do when they graduate from the Technion. ⁵
Number of answers	120	39
Areas in which electrical engineers work	10 general areas were mentioned, such as research and development (19 pupils) and hi-tech (18 students, e.g., "Work in hi-tech companies").	20 areas were mentioned, 11 of them were specific areas presented during the exposure day (e.g., robotics, image processing, artificial intelligence).
Indication of specific topics	Only 4 pupils indicated a specific topic such as robotics.	37 out of a total of 84 items mentioned were specific domains to which the pupils were exposed during the day.
Teaching	2 pupils mentioned teaching (e.g., "Work as teachers or in factories for engineering of electricity").	9 pupils indicated "academic teaching".

⁴ As an anecdote we will add that, in the morning, some of the pupils just copied their answers from their friends (the same exact ignorant answer appeared on several forms of pupils from the same school). This may be explained by the fact that in the morning, some pupils simply did not know how to answer the question. As it turns out, in the afternoon, all of the answers were unique.

⁵ It may be the case that had the pupils been asked also in the morning to mention three items, their morning answers would be more focused. Still, these answers would probably be general in nature.

Technical image	18 pupils mentioned instruments and/or the electricity company (e.g., "Build electrical circuits for instruments"; "Engineering machines, prepare the electrical systems in buildings, etc.").	No technical or tool-oriented answers were given. Only one pupil mentioned the electricity company.
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Table 3 reveals that on the afternoon questionnaire a greater proportion of pupils mentioned a wider variety of specific areas in which electrical engineers work compared with the morning questionnaire, and that the predominantly technical image of EE was transformed over the course of the exposure day. Moreover, from among the twenty domains mentioned by pupils in their afternoon answers, thirteen were mentioned by more than one pupil. The most frequently mentioned domains were software and hi-tech (appeared in 23 answers, 16 of which mentioned the names of well-known companies, such as Intel and IBM); research (10 answers); and academic teaching, robotics, and electronics (9 answers each)⁶. The increase in the number of pupils who mentioned teaching, from 2 out of 124 in the morning to 9 out of 39 in the afternoon, may be explained by the fact that the pupils were influenced by alumni's stories about returning to the academia as graduate students after working for several years in the industry. In this respect, meeting with the alumni achieved its targets.

Observation 2: Reduction in pupils' resistance towards the idea of studying EE and the existence of the exposure day

This observation is based on the analysis of Questions 2, 3 and 4 on the morning questionnaire and Questions 6 and 8 on the end-of-the-day questionnaire. It highlights the fact that although only a few pupils considered the possibility of studying EE when they arrived in the morning, they did not consider it a study topic that was rejected *a priori*, as were other fields.

Question 2 on the morning questionnaire presented the pupils with an alphabetic list of twelve of the seventeen Technion departments. With respect to each department, the pupils were requested to indicate one of the following options: "I would consider studying this

⁶ In addition, "lasers" was mentioned 6 times; "image processing/computerized graphics/animations" was mentioned 5 times; and "information processing", "film dubbing", and "machines" were each mentioned 3 times. The following domains were mentioned only once: multimedia, bio-medicine, artificial intelligence, the electricity company, cellular phones companies, job seeking.

field", "I would, *a priori*, not consider studying this field" and "I am undecided about studying this field". Results are summarized in Table 4, in which the least desired department is listed first (Mechanical Engineering with only 8 pupils who considered studying it). The Department of EE shared the second place from top with the Department of Aeronautical Engineering: only 19 pupils out of 124 (15%) considered studying these fields. Not surprisingly, this data fits the percentages of female undergraduate students learning at the corresponding Technion departments (Technion Report of 2003, p. 47). The percentages of female undergraduate students in these three departments are the lowest in the Technion: Mechanical Engineering – 11%; Electrical Engineering - 13%; Aerospace engineering – 17%.

Table 4: Pupil ratings of Technion departments

	I would consider studying this field	I would not <i>a priori</i> consider studying this field	I am undecided about studying this field	Did not answer
Mechanical Engineering	8	86	29	1
Aerospace Engineering	19	67	37	1
Electrical Engineering	19	50	52	3
Architecture and Town Planning	21	64	37	2
Industrial Engineering and Management	23	59	37	5
Chemistry	24	55	45	0
Physics	30	52	42	0
Biology	31	50	41	2
Computer Science	31	58	31	4
Food Engineering and Biotechnology	34	39	47	4
Mathematics	36	46	40	2
Medicine	49	40	33	2

When comparing EE to Mechanical Engineering and Aerospace Engineering in regard to the data presented in the second column of Table 4, one can see that an *a priori* rejection of EE was *not* dominant as it was with respect to the other two departments that were awarded both the lowest positive rating and the highest *a priori* negative rating. The Department of EE was rated less negatively than were departments such as Chemistry,

Architecture and Town Planning, Industrial Engineering and Management, and Computer Science. This might mean that there is a better chance of changing pupils' attitudes towards studying EE than there is of changing their attitudes towards studying mechanical or aerospace engineering.

Additional data that supports this result in regard to EE can be seen in Table 5, which summarizes pupils' answers to Questions 3 and 4 on the morning questionnaire. As indicated by Table 5, EE was almost never used by the pupils as an example of a field that they *a priori* reject studying. In deep contrast, the Department of Medicine, which received the highest positive rating (indicated by 49 pupils, see Column 1 of Table 4) and was the most preferred field (indicated by more than 30 pupils, see Column 1 of Table 5), was also the department second-most frequently presented as an example of a field whose studying was rejected *a priori*, after Architecture and Town Planning.

Table 5: Examples given by pupils of departments with positive and negative ratings (in ascending order, according to Question 4)⁷

	Question 3: My most preferred field	Question 4: One of the fields that I <i>a priori</i> reject studying
Food Engineering and Biotechnology	10.5	2
Electrical Engineering	6	2.3
Industrial Engineering and Management	8.5	5
Aerospace Engineering	4	5.3
Mathematics	12	5.3
Chemistry	5.5	8
Physics	3.5	10
Biology	9.5	10
Mechanical Engineering	0	13.5
Computer Science	13	16
Medicine	31.5	16.5
Architecture and Town Planning	12	17
Did not answer	8	11

⁷ Fractions in Table 5 indicate situations in which more than one field was mentioned. The single "vote" of the pupil was divided among the different fields according to the number of fields indicated.

If we recall that the data presented in Table 5 were collected in the morning, before any specific context was presented to the pupils, then an attempt to interpret these findings from the pupils' perspective suggests that being hosted by the department of EE led them, if not to consider studying EE, then at least to avoid rejecting the idea *a priori*; this, even before the day's activities began. In other words, while it would have been logical to expect all the results related to EE to be similar to those for aerospace engineering and mechanical engineering, it is suggested that the mere existence of the exposure day changed the pupils' attitude from *a priori* rejection to undecidedness. As can be seen in Table 4, the highest rate of indecision is mentioned with respect to EE.

This interpretation can be explained by the fact that studying EE was not part of the pupils' awareness when they arrived at the exposure day, just as they did not consider studying aerospace engineering or mechanical engineering. However, their arrival at the department building and the positive treatment they received (see Section 2.3), brought about an increase in their awareness of the department, and caused them, if not to consider studying EE, then at least to express indecision whether to study it or not. As shown in the following paragraphs, the pupils' positive attitude towards the department, as expressed on the end-of-the-day questionnaire, was even stronger.

First, in response to Question 8 on the end-of-the-day questionnaire: "Will you consider studying at the Department of EE at the Technion?", 29 of the 45 pupils who responded answered positively (65%), four answered "Maybe" and 11 pupils answered "No" (one pupil did not answer at all).

Second, in response to Question 6 on the same questionnaire: "Will you recommend to your friends that they attend a similar conference next year?", 43 of the 45 pupils indicated "Yes" and only two indicated "No". Here are several pupils' explanations for their affirmative answers.

- "I think it is important to attend any conference in order to become familiar with new domains and to break stereotypes that exist about domains like this one (especially for girls)".
- "It [the exposure day] was very interesting. The lectures were interesting, we received warm treatment and our comfort was taken care of".
- "It opened up for me a totally different point of view than I had when I first read the flyer on EE that was distributed".

- “I was exposed to information about EE and how it can be used in the future, which, had I not attended the exposure day, I would not have known”.
- “I learned today that there is more about this department than just studying about electricity”.

We chose to present only those answers that specifically addressed the exposure day and not those that presented non-specific arguments, such as the importance of having data on which to base ones' decisions (e.g., "Knowledge == Power"). In summary, the exposure day not only reduced pupils' resistance towards the idea of studying EE, but also expanded the attendees' perspectives regarding EE as a profession in general, and the Technion's Department of Electrical Engineering in particular.

Observation 3: Pros and cons of studying electrical engineering

At the end of the exposure day, when more specific questions could be posed, the pupils were asked questions that addressed the pros and cons of studying at the Department of EE at the Technion. These questions included Question 4 “What might make you choose to study at the Department of EE at the Technion?” and Question 5 “What might prevent you from choosing to study at the Department of EE at the Technion?”. As it turns out, the same three categories emerged from an analysis of the answers received to both of these questions, namely, Interest, Challenge and Suitability. The **Interest** category includes arguments that explain that the subjects studied at the department are viewed as being interesting. The arguments in the **Challenge** category refer to the fact that the field is demanding, difficult, and challenging, as well as to the high academic level of the Department of EE at the Technion. The **Suitability** category refers to statements such as "I am suited/I am not suited for EE", "It depends on whether I am accepted to the department", "My talent is suited/is not suited for the field", and so on. Table 6 presents a breakdown of the answers given (45 in all) according to the category they address.

One clear observation that emerges from Table 6 is that while almost the same number of pros and cons was presented in the Interest category, more arguments were presented as cons in the Challenge and the Suitability categories.

Table 6: Pros and cons of studying at the Department of EE at the Technion

Category	Pros (Question 4)	Cons (Question 5)
Interest	28 pupils, out of which 8 indicated one or more specific EE attractive domain, such as robotics, computers, software and physics.	25 pupils, out of which 7 explicitly indicated that EE is not interesting; 6 explained that they are interested in a different department; and 12 indicated one deterring area of study such as physics or mathematics.
Challenge	3	14
Suitability	2	7

The similarity in the number of arguments in the Interest category can be explained by the fact that it is natural that not all people find EE to be an interesting profession, and thus, it makes sense that the number of pupils who find EE interesting is similar to that of those who do not find it interesting. In addition, it is clear that interest (or a lack thereof) is a dominant factor in the pupils' choice of EE. The dominance of the category of Interest is also highlighted by pupils' answers to Question 7 on the end-of-the-day questionnaire, in which they were asked whether they would recommend to their friends that they study at the Department of EE. Twelve pupils (out of 45) used the Interest factor as a reason for studying EE. None of them addressed the Challenge or the Suitability categories when referring to their recommendation to their friends' possible choice of EE.

The fact that the numbers of pros and cons for one category are almost equal highlights the other two categories – Challenge and Suitability – in which statements were mainly con arguments. We explain this observation using theories that suggest that males and females ascribe success and failure to different factors (see for example, Babcock and Laschever, 2003). According to these theories, while men tend to ascribe their success to their personality, women tend to ascribe their success to other, external factors, such as luck; and vice versa: men tend to ascribe their failure to external factors, while women tend to ascribe their failures to their personality. Accordingly, a woman in general, and a female high school pupil in particular, may have the following unconscious stream of thoughts with respect to whether or not she should study at the Department of EE: "If EE is a challenging, difficult and demanding profession, I may fail in my studies. If I fail, then something must be wrong with me. So, I will not consider studying it". Furthermore, since

studying at the Department of EE is difficult, demanding and prestigious, "I probably am not suited for it and might not even be accepted to the department".

Interestingly, only three pupils mentioned the fact that the population of the Department of EE is predominantly male as a *pro* argument for studying at the department. This observation highlights the fact that the masculine image of the profession is not a dominant factor (at least in our case) for female pupils when they consider what academic field to study. Rather, their level of familiarity with the domain (as is indicated by Observation 1), together with the interest they find in EE, are found to be more dominant factors in their choice to study EE (or not).

5. Concluding remarks

The aim of the study described in this paper was to examine the perception of EE by female high school pupils at the beginning and at the end of an exposure day organized by the Technion's Department of Electrical Engineering. During that day, the pupils were exposed to the department in general, and to many of the topics that are researched and studied in it, in particular. The rationale for the day stemmed from the very salient under-representation of women among the undergraduate students, as well among the graduate students in the department.

Three main observations were discussed. First, we illustrated how such a day can dramatically change the perception of EE as a profession. Second, we showed how the very existence of such a day can increase the pupils' willingness to consider studying EE. Finally, we discussed pro and con arguments, given by the pupils, for studying at the department.

As a conclusion, we wish to discuss three implications that can be derived from our study. These implications refer to the way in which the profession of EE may be presented when the objective is to attract more women to the field.

First, it seems that, as in the case of computer science, the profession of EE suffers from a misconceived image among the public. In the case of computer science, many people think that to be a computer scientist means sitting in front of a computer screen all day long, without communicating or socializing with other people (Margolis and Fisher 2002). In the case of EE, it was clear from the pupils' responses at the beginning of the day

that their image of EE is very technical and that they are unaware of the social, scientific, multi-faceted nature of the field. The exposure day described in this article illustrates that this image can be changed in a relatively short period of time, provided such a day is well organized and planned so that it includes the relevant ingredients that inspire a more realistic image of the profession. Specifically, we argue that emphasis should be placed on the multi-disciplinary nature of the field in general, and on the direct influence of this trait on our society in particular.

Second, we suggest exposing the pupils attending such a day to female role models (as was done in the case described in this article). Such exposure enriches the image of the profession by adding the individual perspective of the profession to the more global perspective that was explained in the previous paragraph.

Finally, we suggest that EE *not* be presented as a topic that is exceedingly challenging. As mentioned in Observation 3 (Section 4), the female pupils might recoil from such a description. Indeed, a realistic picture of the field should be portrayed. Presenting EE as a multi-facet field that is connected to many areas in our life, as well as the presence of role models during the entire day, serve this purpose effectively, as was described in the two previous paragraphs.

Further to the work described in this article, in order to study the long-term influence of such an exposure day, we plan to examine the way in which the female high school pupils who attended the exposure day perceive EE at several future points in time. Such an exploration will help us refine our observations, as well as our recommendations about the preferred way in which the profession of EE should be presented to a female audience that is not familiar with the nature of the profession.

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Appendix 1 – Morning Questionnaire

One-Day Conference for Female High-School Pupils Excelling in Mathematics December 31st, 2003

Greetings,

The objective of the following questionnaire is to help the conference organizers understand your attitudes towards studying at the Technion. The questionnaire is anonymous.

Thank you for your cooperation.

1. Name of high school: _____

2. Among other fields, the Technion offers the following fields of study. With respect to each field, please indicate + in the appropriate column:

	I would consider studying this field	I would not <i>a priori</i> consider studying this field	I am undecided about studying this field
Architecture and Town Planning			
Biology			
Aerospace Engineering			
Electrical Engineering			
Food Engineering and Biotechnology			
Mechanical Engineering			
Industrial Engineering and Management			
Chemistry			
Computer Science			
Mathematics			
Physics			
Medicine			

3. The field I prefer **most** from the above list of fields is: _____
Because

4. Select one of the fields that you *a priori* reject studying. The field is: _____
The main reason I am not interested in studying this field is:

5. What do you think EE graduates do when they graduate from the Technion?

Appendix 2 – End-of-the-day Questionnaire**One-Day Conference for Female High-School Pupils Excelling in Mathematics
December 31st, 2003**

Greetings,

Please answer the following questions according to what you have learned during the conference. This questionnaire is anonymous as well.

Thank you for your cooperation.

1. Name of high school: _____
2. What would you say if you were asked to explain what EE is in two sentences?
3. List at least three things that people who work in electrical engineering do when they graduate from the Technion.
4. What might cause you to choose to study at the Department of Electrical Engineering at the Technion?
5. What might prevent you from choosing to study at the Department of Electrical Engineering at the Technion?
6. Would you recommend to your friends that they attend a similar conference next year? yes no
Because
7. Would you recommend to your friends that they study at the Department of Electrical Engineering at the Technion? yes no
Because
8. Will you consider studying at the Department of Electrical Engineering at the Technion? yes no
Because