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Sue Ellen Haupt

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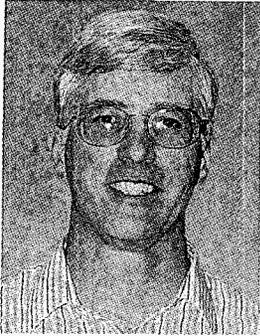
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Randy L. Haupt
 Pennsylvania State University
 Applied Research Laboratory
 P.O. Box 30
 State College, PA 16804 USA
 Tel: +1 (814) 863-3324
 E-mail: rh45@psu.edu

Why Are There Fewer Women in Engineering?

Sue Ellen Haupt

Computational Mechanics Division, Applied Research Laboratory
 The Pennsylvania State University
 P.O. Box 30, State College, PA 16804 USA
 Tel: +1 (814) 863-7135; E-mail: seh19@psu.edu

No, Randy wouldn't touch this topic with a ten-foot pole, but since I'm a female engineer/scientist, I'll give it a try. By now, everyone has heard the flap over the comments of Lawrence Summers, president of Harvard, questioning whether women have the same innate ability in science and math as do men. In all fairness to Dr. Summers, he was invited to speak at a conference sponsored by the National Bureau of Economic Research as a renowned economist, rather than as a university president, and didn't expect his speculations to get such wide press. Some women in the audience were quite offended. In fact, Nancy Hopkins, a 1964 Harvard graduate who is a Professor at MIT and one of those responsible for bringing to light the marginalization of women in academia, chose to walk out of Summers' talk [1].

Since that day, those comments have been debated in the popular literature. Some decry the comments as taking a giant step backward, while others defend the right of Summers to say them. Dr. Summers based his suggestion on a recent study that shows that, while adolescent girls have caught up with the average boys' scores on standardized math tests, there are still more boys than girls in the top 5%. The authors of the study cited protested the (mis)use of their findings, since they argue that any apparent discrepancy may be related to societal factors [2]. The whole incident also brought before the public the fact that a significantly smaller percentage of women are gaining tenure in science and engineering at Harvard since Dr. Summers took the leadership position there [1].

So, what is the real explanation for the paucity of women in engineering? Is there really a difference in ability? There are many opinions, of course, but it is hard to dismiss the theory of differen-

tial socialization when you watch young girls grow up. In my baby-boom generation, many girls were actively discouraged from going into science or engineering. My own family is an example. My father pushed my brother into engineering in the post-Sputnik '60s despite his lack of interest. It wasn't until after a stint in the Army, when he declared his independence and changed his major to business, that my father finally gave up. A decade later, when I announced my intention of a technical career, my father explained that it was better for girls to be nurses and mothers. Now there is nothing wrong with choosing nursing or any other female-dominated career, but what is wrong with the choice of science, technology, and math? And why can't a woman have a technical career plus be a mother? When I got to college and was trying to distinguish between technical careers, my fatherly academic advisor hailed the advantages of a career in technical writing (I was getting As in all my math and science courses at the time). I have heard many similar stories from both my colleagues who, like me, did not listen to their fathers or advisors, as well as from some women who did conform to the expectations of the time and have also wondered, "What if?" So, you say that isn't happening any longer. Or is it, yet more subtly? Do parents really work as hard to help their daughters explore technical careers as they do with their sons? I'm sure many do, but I have observed counterexamples. Do all school counselors and teachers encourage their female students to the same extent as the males? I applaud those who do, but recognize that they are not the only ones out there.

For those of us women who do choose technical careers, what is the difference in the careers and choices of women as compared to men? In spite of the fact that the percentage of women entering engineering and science careers has been

increasing, the number at higher ranks has not increased as quickly, after considering the appropriate time lag. A recent NSF study on faculty careers brought some interesting issues to light. It documented that female scientists and engineers were less successful at progressing in academic careers than men. They found that differences in tenure rate due to gender alone were statistically insignificant. Instead, they attributed the differences to the fact that women who are married or have children are less successful than are men with the matching characteristics [3]. This study begins to get to the heart of the issue. The undeniable difference between women and men is that women can bear children. As close as many fathers are to their infants and children, they do not carry them in their womb or feed them at their breast. The childbearing years happen to coincide with the most important years for establishing a successful career, whether in academia or industry. We all know women who appear to be doing it all successfully. I have many friends who fall into that category, until you hear the inside story: how tired and frustrated they are at being forced to constantly make the difficult choices of how to spend their time. I recall in my early years as a postdoc reading a biography of a woman who was the first to "make it" in her field. The postscript to that story was the fact that she had several divorces and was estranged from her children. I suppose I admire her for paving the road, but should all women have to give up their family for a technical career? Should women have to remain childless to get ahead in technical fields? Men who want a significant role in childrearing and family life are faced with similar difficult choices. Some choose to criticize these engineers and scientists as not being as driven to excel in their field. Nothing can be further than the truth: not only are many of these folks driven in their technical career, but also in their personal life. However, life does not give them extra hours in the day.

One solution sometimes proposed is to recognize that priorities might be different at differing stages of family life. Some women, including myself, choose to back off the career for a while during the years when the children are young, and then attempt to resume them at full force when the time seems right. However, many women find roadblocks at resuming their careers after a hiatus [4]. This issue is not unique to women in technical fields, and there is beginning to be a literature around this issue. Most articles I have seen cite examples of women who were high-level managers until they realized they needed a few years concentrating on child rearing. When they attempted to resume a career, they find that time has passed them by. For some, their field of expertise has rapidly changed and they are no longer qualified at the same level. For others who may have tried to stay current, the perception of a lack of interest in a career has killed all possibilities [5]. In fact, that is often true for parents who stay in the workforce. I read an article recently talking about how faculty who are tenure track try to hide the amount of time they spend with their family. In an attempt to appear more serious about their career [6]. In the process of hiding their time, they are often forced to spend less time in family pursuits. Why does our culture so often expect an either/or choice of how to spend our time?

At the same time, we are worrying about fewer Americans choosing technical careers. In fact, the number of bachelors degrees in engineering awarded to American males dropped by 16.2% between 1994 and 2001, and masters degrees dropped 21.9%. Perhaps we should look at what makes a technical career less appealing to both women and men. There are still lots of students who appreciate a challenge and are willing to work hard to learn difficult subjects. Medicine and law do not have a scarcity of applicants. Those fields are also closer to gender parity. Some speculate that those fields are more popular because during the

difficult training years, a goal of a better time is in sight. There are clear rewards in terms of career path and salary expectations. What are we demonstrating to our engineering undergraduate and graduate students that is different? Many watch their professors work long hours on a constant basis at the expense of their family. After all those years of schooling, many are still in a position where they have to find support for their own salary plus that of their research group. Why do we not think this is unappealing to our students?

So what can we do? Let's start with the assumption that there is something to be added by including more women in the field of engineering: perhaps that is purely in number, or perhaps we could see benefits of a different point of view on problems. In addition, we want to encourage more children of both genders to go into engineering. First, we must make engineering an appealing career. Maybe it is too obvious to those of us already here, but the excitement and joy of discovery and at seeing our design work is not so apparent to the casual observer. We as engineers are responsible for advertising the parts that keep us in our careers. Second, we may need to work harder to help young girls and minorities believe that there is a place for them in the field. Many of them do not see the possibilities, and sometimes a bit of personal encouragement can make all the difference in the world. Third and most importantly, we need to think through whether there should be alternate career paths, which don't require the huge personal sacrifices at the same time when many families have young children that require that same time. This is not just a women's issue, but rather one that faces many men, as well. Let's face it: we have not been very flexible to date. Is that really necessary?

In summary, it's pretty clear that I believe that women can "do" math, science, and engineering, given the chance. Randy and I have always taught our daughters that they are capable of doing whatever they choose, and have created opportunities for them to discover their abilities in those areas. Our oldest will enter the university in the fall, majoring in computer engineering. The younger has yet to make her choices. But we want to be sure that the choices of she and her peers are determined by interest and aptitude, rather than solely by the fact that they are female.

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Introducing the Author

Sue Ellen Haupt is a Senior Research Associate in the Computational Mechanics Division of the Applied Research Laboratory at Penn State. As a cross between a mechanical engineer and an atmospheric physicist, her specialty is in applying novel numerical techniques to problems in fluid dynamics. She earned her PhD from the University of Michigan in Atmospheric Science in 1988. She also holds an MS in Mechanical Engineering from the

Worcester Polytechnic Institute (1984), an MS in Engineering Management from Western New England College (1982), and a BS in Meteorology from The Pennsylvania State University (1978). She is coauthor of *Practical Genetic Algorithms* (Wiley and Sons, 1998, 2004) and has published over 50 technical and outreach journal and conference papers. To survive as part of a dual-career couple, she has been very versatile, doing research and teaching in departments of mechanical engineering, physics, applied mathematics, and atmospheric sciences. Her prior affiliations include Utah State University, University of Nevada/Reno, University of Colorado/Boulder, US Air Force Academy, and National Center for Atmospheric Research. Parts of her career have been at half-time pay level, and have included some six-month periods off formal work for more attention to family issues. She has two teenaged daughters and, in addition to research, enjoys working with campus SWE (Society of Women Engineers) groups and Girl Scouts. She and her husband, Randy, co-chaired the IEEE Aerospace Committee for the Junior Engineering and Science Conference for six years. ☯

Hidden Word



Fred Gardiol
chemin des Graminees 11
CH-1009 Pully, Switzerland
Tel: +41 21 729 70 39
Fax: +41 21 729 70 39
E-mail: fred.gardiol@hispeed.ch

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Y	D	C	I	T	E	N	G	A	M	A	N	T	L	E
T	S	U	O	N	E	N	S	U	U	U	B	O	L	T
I	B	I	O	N	I	C	S	S	I	T	R	O	A	N
R	A	B	O	L	E	I	H	E	E	L	H	O	C	E
A	L	I	E	N	C	R	L	N	O	N	D	O	U	U
L	A	D	I	T	I	I	E	N	I	I	I	T	R	Q
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M	O	T	T	O	B	R	N	C	H	E	I	A	U	S
I	V	O	R	Y	A	E	A	I	H	S	N	T	L	B
S	N	P	O	N	P	R	H	M	N	T	I	R	Y	U
P	A	R	K	I	D	E	C	N	A	T	S	I	D	S
E	T	S	E	A	R	A	L	C	Y	L	H	G	I	H
E	I	R	M	M	I	I	O	G	N	A	I	G	S	E
D	O	O	H	O	N	R	S	R	A	K	N	E	I	L
Y	N	W	O	D	K	A	E	R	B	E	G	R	A	L

Alien, Author
Banyan, Bionic, Bolt, Bone, Bottom, Breakdown, Broad, Business
Call, Channel, Cinch, Close, Cloud, Cone, Cork
Diminishing, Discard, Disk, Distance, Domain, Drink
Eagle
Guild
Highly, Hood
Iodine, Ivory
Lake, Large, Lightning, Lobar
Magnetic, Mantle, Modeling, Music
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Park, Pinhole, Profile
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Shell, Shrift, Similarity, Speedy, Stroke, Subsequent
Technicity, Tidal, Trigger, Type
Ulam
Yore