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ABSTRACT

The Center for Children and Technology is investigating issues of gender and diversity in how students, particularly girls, engage with technology. It studies how people construct meaning in relation to different technological environments, examining social and cultural barriers affecting people's engagement with technology. It also investigates technological environments that engage diverse learners. It finds that the gender problem is highly overdetermined, particularly regarding technology. It is important to engage both boys and girls with technology, incorporating multiple perspectives and varying themes. In education, this means identifying alternative pathways that invite students to engage in different kinds of relationships to technology. One telementoring program links high school girls to female professionals in science and technology fields for ongoing advice and support. This program includes facilitated group discussions with online scenarios in which participants respond to hypothetical situations relevant to their own lives. Researchers must use a constructivist approach to understanding, with diverse learners invited into flexible technological environments that do not restrict parameters for engagement to predetermined sets of metaphors, images, storylines, or pathways. (SM)

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GENDER AND TECHNOLOGY: DESIGNING FOR DIVERSITY

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Gender and Technology: Designing for Diversity

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During the past ten years, a research and design group at the Center for Children and Technology have spent time investigating issues of gender and diversity as they relate to the ways in which students, particularly girls, use and engage with technologies. Our approach to these issues has been both psychological and sociological: we have investigated the ways in which children and adults construct meanings in relation to different technological environments, and we have examined the social and cultural barriers that tend to effect the ways in which we engage with technologies. We have also experimented with designing technological environments that can engage diverse populations of learners -- not just the white boys.

What has become clear to us over time is that the gender problem is highly overdetermined, particularly with respect to technology. That is, there are a variety of forces at play that affect our understanding of gender and make it very hard for us to think our way out of more or less conventional understandings of "masculinity" and "femininity." These forces are deeply intertwined and woven together in a complex fashion.

They include sociological issues that have to do with the fact that girls and students of color still opt out of advanced level science and math courses at a greater rate than do Caucasian males. As a result, scientific, engineering, and technological fields that are responsible for technological design are still largely dominated by white men.

They include economic factors, particularly in relation to interactive *edutainment* products, that make it much more likely that the already commercially successful products, usually linked to a television series, are the ones to find shelf-space in CompUSA and other large retail outfits.

And they include psychological factors that suggest there are ways in which we, as consumers, have been strongly encouraged to collude in the kinds of narratives and story lines that the vast majority of interactive products offer -- particularly in relationship to the gaming industry. In this paper we focus on the latter point: the *psychological paradox*. This paradox confronts us with the question of how we address issues of concern to young women that are glaringly absent in technological design without colluding in stereotypical understandings of femininity.

In the late 1980's we did a series of studies that focused on adult women and men who were working in technological professions to begin to unravel this psychological paradox. Among the people we interviewed were computer scientists, programmers, engineers, as well as architects, film

makers, and people working in multimedia production fields. We wanted to undertake a study that would not focus exclusively on barriers, but look closely and carefully at women's accomplishments. Most of the research work conducted prior to our investigations was based on a deficit model and it assumed that women lacked the necessary knowledge and experience to engage with technology. We were interested in the stories of technologically accomplished women: how did they come to do what they are doing and how did they represent and interpret their work.

What emerged as the most interesting themes in this research was how they described what they liked about their work, and how they represented their relationships to technologies. These technologically sophisticated women were most interested in aspects of their work that permitted them to make technologies useful and accessible to others. They tended to see the technologies they were working with as transparent objects – tools that enabled them to accomplish tasks that genuinely aided people in their work. Technologically sophisticated men, in contrast, were much more interested in the machines themselves. When asked about aspects of their work that genuinely engaged them, they often described complex programming problems that took them deeper and deeper into the technology itself.

In a related study, we asked this same group of men and women to describe the perfect technological instrument by telling us what a futuristic version of the one they currently work with would look like. The descriptions they came up with were provocative, imaginary and striking in their uniformity along gender lines. Here are two descriptions, both written by computer programmers, the first by a woman, the second by a man:

The "keyboard" would be the size of a medallion, formed into a beautiful piece of platinum sculptured jewelry, worn around one's neck. The medallion could be purchased in many shapes and sizes. The keyed input would operate all day-to-day necessities to communicate and transport people (including replacements for today's automobile). The fiber optic network that linked operations would have no dangerous side effect or by product that harmed people or the environment.

A direct brain-to-machine link. Plug it into a socket in the back of you head and you can begin communications with it. All information from other users is available and all of the history of mankind is also available. By selecting anytime period the computer can impress directly on the user's brain images and background information for that time. In essence a time-machine. The user would not be able to discern differences between dreams and reality and information placed there by the machine. (perhaps this is all a nightmare).

In analyzing these fantasies we looked at the ways in which men and women related technology to their lives, their bodies, the physical world, and their creativity. What we found, in summary, was that women wanted small portable objects that allowed them to communicate with others, share resources and experiences, and helped to integrate the different aspects of their lives. Men, by contrast, wanted "magic wands" that allowed them to

transcend the limitations of time, space and their physical selves -- bionic extensions that allowed them to have a direct impact through thought alone on the universe. These gender differences were remarkably consistent across the fantasy scenarios produced by men and women in this study. Similar studies with pre-adolescent boys and girls of different backgrounds exhibited some of these same differences (see Table).

What does this tell us about how we think about the development of new technologies? Women are much more likely to be concerned with how new technologies can fit into the social and environmental surround, whereas men are much more likely to be preoccupied with doing things faster, more powerfully, and more efficiently regardless of social and environmental consequences. On the other hand, women are *far less likely* to push the technological envelope and tend to be willing to make do with available tools. Men, in contrast, tend to draw upon their technological imaginations to extend the capabilities of technologies and to literally "go where no man has ever gone before."

When thinking about the design of technological environments -- particularly in relation to entertainment and educational products -- it has been exceedingly difficult for us to imagine our way out of these antithetical positions. The common approach in interactive design, or perhaps the path of least resistance, is to develop victory lines that reinforce these extremes. The result is that *Mortal Combat* becomes the archetypal video game for boys. In the girls arena, programs like *McKenzie & Company* are beginning to emerge. This product presents scenarios that revolve around how to handle problems with boyfriends or would-be boyfriends, or how to dress and what kind of makeup to wear.

These things are not bad in and of themselves, but when embedded within the confines of an electronic universe they take on a significance and a weight that they do not have in real life. In the same way that the violence in a game like *Mortal Combat* exaggerates the fantasy life of little boys, the social decision making trees embodied in a game like *McKenzie & Company* are out of proportion to the kinds of human problem-solving situations that girls engage in all the time.

What's wrong with products like these is that they exacerbate an already exacerbated situation and it becomes very hard for us to imagine a kind of design that does not privilege an either/or paradigm: *Conquest* or *A Day at the Mall*. What we need to do to engage both boys and girls with technology that is neither overdetermined or exclusive is to think about designs that can incorporate multiple perspectives and varying themes. In the education arena this means that seemingly contradictory ways of thinking might coexist within the same technological environment. In a technology-

TECHNOLOGY

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<p>Women fantasize about it as a MEDIUM</p>	<p>Men fantasize about it as a PRODUCT</p>
<p>Women see it as a TOOL</p>	<p>Men see it as a WEAPON</p>
<p>Women want to use it for COMMUNICATION</p>	<p>Men want to use it for CONTROL</p>
<p>Women are impressed with its potential for CREATION</p>	<p>Men are impressed with its potential for POWER</p>
<p>Women see it as EXPRESSIVE</p>	<p>Men see it as INSTRUMENTAL</p>
<p>Women ask it for FLEXIBILITY</p>	<p>Men ask it for SPEED</p>
<p>Women are concerned with its EFFECTIVENESS</p>	<p>Men are concerned with its EFFICIENCY</p>
<p>Women like its ability to facilitate SHARING</p>	<p>Men like its ability to grant them AUTONOMY</p>
<p>Women are concerned with INTEGRATING it into their personal lives</p>	<p>Men are intent on CONSUMING it</p>
<p>Women talk about wanting to EXPLORE worlds</p>	<p>Men talk about using it to EXPLOIT resources and potentialities</p>
<p>Women are EMPOWERED by it</p>	<p>Men want TRANSCENDENCE</p>

based curriculum, this means identifying alternative pathways that invite students to engage in different kinds of relationships to technology.

We are at a pivotal moment in the evolution of technology and education. Technologies can now be easily designed to embrace different ways of knowing, inviting diverse learners to express and develop multiple points of view. Technologies are now capable of richly supporting three ingredients that make for a kind of learning that is inviting to all students, particularly girls: exploration, interpretation and communication. The power of discovery lies in being able to build one's own meanings, and debate and discuss one's ideas with others. Distributed technologies like the Internet are well poised to support this kind of learning.

During the past few years we have been experimenting with communication technologies to create new environments that support young women. One such project is the *Telementoring* program, which uses telecommunications to link high school women to practicing female professionals in science and technology-related fields for ongoing advice and support. The primary goal of the project was to create on-line environments where young women from diverse backgrounds could safely discuss issues and engage in problem-solving around conflicts they confront in science and technical courses. More importantly, we were interested in creating environments that dealt with the complexity of issues that are involved in pursuing a field that is often foreign and unwelcoming. Through this work, we have learned a great deal about the social surrounds that are necessary to supporting such on-line environments. The program has evolved a range of on-line structures for students and mentors to engage in on-line conversation (both one-on-one exchanges and group discussions). Central to large group discussions was the use of on-line scenarios where participants could respond to a hypothetical situation that resonated with their own lives. Scenarios were designed to be multifaceted and complex and to capture some of the competing concerns that students often face, such as one about making college choices:

This scenario is meant to inspire an honest and open exchange of ideas and opinions on making difficult choices about life after high school. No ideas are stupid. Here's the scenario:

Maria was accepted to a university out of state that has many courses she would like to take. Yet she is considering going to the local community college since it is affordable and she thinks she could transfer to a four year college down the road. Deep down, the real deal is that Maria is conflicted about what to do since she would like to go away for college but at the same time she is not sure she is ready to leave her family and her hometown.

Her friend Karyl is a junior year student and is interested in an environmental engineering program at a top college. The only problem is that she is not positive she wants to pursue engineering exclusively (she likes the performing arts) and there do not seem to be many other interesting courses that she could take at this college.

You are eavesdropping on Maria and Karyl's phone conversation:

What do they talk about?

How might Maria and Karyl decide on where to go to school? What choices do they have?
What did mentors take into account when deciding what to pursue after high school?

This scenario was posted by a mentor to students and other mentors who were subscribed to the electronic mailing list set aside for these large group discussions. The scenario was designed to initiate conversation and it was the mentor facilitator's job to invite students and other adult mentors to share their ideas in response to the larger theme of choosing colleges. The most striking aspect of these discussions was the extent to which mentors and the young women touched on a broad range of issues in response to a somewhat focused discussion topic on college choices. Topics discussed included conflicts with parents, career issues, relationship issues, peer pressure issues, and attitudes towards mathematics, very often in the context of one message. This discussion environment, with the help of skilled mentors, proved to be the kind of space that supported the integration of multiple ideas and concerns. This kind of integrated thinking is rarely fostered, let alone allowed, in classroom settings. One telling example was that of a student who replied to the conversation about the college scenarios in this way:

> Hey everybody,
> This is gonna be quick because I'm really tired. I'm not really sure
> where I'm going. Maybe Lehman college, maybe Long Island University, maybe
> the University of the Arts in Philly. The only thing I'm sure of is that
> I'll be getting my degree in music. I might also get my degree in music
> therapy. I wanted to do engineering, but I hate math. I'm kind of confused
> to say the least. I have college problems and high school problems and
> boyfriend problems, and can anyone tell me if they stop soon? I feel like
> a slacker sometimes. Well it's time for bed so,
> Later! J

A critical factor in the success of these discussions was the presence of skilled adult facilitators who could affirm, validate and highlight important issues that were raised by students and other adults in the forum. Successful facilitators were those who were able to deal with the multiplicity of issues that students raised in relationship to making choices about their futures. This involved responding to the personal issues that students raised as well as the more academic ones, as was the case of one mentor who responded to the students' posting that was previously mentioned:

Hi J,

Glib answer:

boyfriend problems stop when you ditch boyfriend
high school problems stop when you graduate from high school
college problems stop when you get out of college
So yes, in about 4 years, these problems will probably be over,
unless you forget to ditch boyfriend!

Actually, you don't sound like a slacker, you sound like you have a dream, having music in your career, whether as a musician or a therapist (or other ways which you might discover in your future.) Having a dream is a good place to start, because you can think about your choices in the context of that dream. Good things happen to those who actively pursue their dreams, I think they turn out to be happier people for it.

So ask yourself how the programs available at Lehman, Long Island University and University of Arts in Philly fit in with your music interests. Tell us about it, we'd like to know! If there's other college issues on your mind, you can dump those here too. Maybe some other participants might have similar college questions, or suggestions. Get some sleep! (Mentor)

As educators, our inclination is to often privilege certain kinds of conversation over others and to diminish the importance of personal, affective issues by considering them tangential to young women's decision-making processes and their pursuit of academic studies. As designers, our tendencies are often to capitalize on what we think of as girls' real interests: boyfriends, clothing, and make-up. Unlike commercially available software programs which concentrate solely on boyfriend issues to the exclusion of all others, carefully constructed on-line environments like those we have developed in the Telementoring project enable young women to flexibly explore multiple issues in the larger context of their lives and in the company of diverse people with different experiences. As a result, these technologies can be used to create exciting new opportunities for the kind of learning that young women value -- the kind that starts where young women are at and takes them to another place without privileging one extreme over the other.

Communication environments are not pre-determined and therefore offer tremendous potential for all students to raise questions, to voice their opinions, and to creatively make these environments their own in a dynamic and interactive way. The distributed architecture of networking technologies puts the power of experimentation, interpretation, and communication into the hands of individual users. As a result, we are beginning to see some interesting developments in Cyberspace, with role-playing coffee cafes largely populated by women coexisting alongside the more ominous Dungeons and Dragon games. Software companies are quickly recognizing that girls are an

untapped market and are scurrying to understand what appeals to them. Researchers studying computer use and play are finding that open-ended problem-solving games and software appeal to both girls and boys alike.

The danger, however, remains that we will slip back into conventional understandings of masculinity and femininity in constructing new technological environments. To avoid this, a new research methodology is needed that moves well beyond the standard market research paradigms that continue to point out that girls want Barbies and boys want Power Rangers. At the heart of this new methodology is a constructivist approach to understanding where diverse groups of learners are invited into flexible technological environments that do not restrict parameters for engagement to a predetermined set of metaphors, images, story lines, or pathways. As researchers, we must take note of the kinds of *choices* for interaction and experimentation that users make in these flexible, yet complex environments. In doing so, we can begin to uncover the ways in which technologies can support a new kind of learning that values and builds upon the diverse perspectives of all learners.

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