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ABSTRACT

Despite receiving over 50% of associate, bachelor's, and master's degrees in the United States in 1990, women earned only 15% of engineering bachelor's degrees. Polynesian and Filipino women compose an almost vanishing percentage of these engineering graduates. To make visible the social obstacles minority women engineers experience, this paper includes narratives from four women who are close to completing or have recently completed degrees in civil or mechanical engineering. Issues of power, identity, gender, and race emerged in these narratives. Each woman constructed multiple social identities reflecting the norms of her social group. Three believe success as an engineer requires conflicting identities and the fourth woman's story reveals how immersion in a girls' college preparatory academy shielded her from negative ethnic, class, and gender narratives. Contains 21 references. (Author/DDR)

MULTIPLE WORLDS/MIS-MATCHED MEANINGS: BARRIERS TO MINORITY WOMEN ENGINEERS

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Abstract

Despite receiving over 50% of U.S. associate, bachelors, and masters degrees in 1990, women earned only 15% of engineering bachelor's degrees (NSF, 1992). Polynesian and Filipino women compose an almost vanishing percentage of these engineering graduates. To make visible the social obstacles minority women engineers experience, narratives were collected from four who were close to completing or had recently completed degrees in civil or mechanical engineering. Issues of power, identity, race, and gender emerged in their narratives. Each woman constructed multiple social identities reflecting norms of her social groups. Three believed success as an engineer required conflicting identities. The fourth woman's life story reveals how immersion in a girls'college preparatory academy shielded her from negative ethnic, class, and gender narratives.

Narratives are interpreted through Butler's sex/geder theories, Bhaba's post-colonial theories of mimicry, Bourdieu's concepts of social capital and habitus, Bakhtin's theory of speech genres, and Stanton-Salazar's concept of social networks. The results imply that K-12 educators, especially in primary grades, should work to involve families in the school socialization of minority students. Mainstream educators need to examine practices and policies that categorize students into groups with unequal learning opportunities. Science educators K-20 need to be provided with strategies to alter dominant social norms and narratives which reduce the entry of gender and ethnic minority students into science and engineering.

Multiple Worlds/Mis-Matched Meanings: Barriers to Minority Women Engineers

Nearly half a century has passed since Congress established the National Science Foundation in 1950 with the mission "to initiate and support...science education programs...and engineering education programs at all levels" (Suter, 1993). Documents such as the NSF's Indicators of Science and Mathematics Education 1992 (*ibid*) contain detailed, fine-grained demographic, gender, and ethnicity data ranging from the "percent of families with one parent" (p. 7) to "percent of high school graduates completing selected science and mathematics courses" (p. 249). Unfortunately, even detailed statistical data does not provide educators with the meaningful insights that come from narratives grounded in the lives of minority individuals. Narratives have the potential to disrupt simplifying stereotypes and make visible complex school socialization processes. Moreover, by grounding individual success or failure in historical events and interactions, narratives can help educators modify school policies and classroom practices.

By unpacking the effects of race, gender, class, and culture, narrative analysis provides a way to understand the success or failure of individuals to become members of particular social groups. Stories illuminate how ideologies are conveyed, internalized, and materialized as individuals become initiated into social groups with varying amounts of power, status, and access to societal resources (Althusser, 1971; Bourdieu, 1977; Bakhtin, 1986; Butler, 1990, 1993). In this light, the case studies of four Polynesian women who relate the experiences they consider relevant to entry into the non-traditional field of engineering may help to map the social networks of unfamiliar cultural terrain.

A social capital/social network concept of identity formation departs from the conventional wisdom that assumes academic success is based on innate talent. "The cream will rise to the top" is a saying that implies schooling, culture, and social context have little relevance to adult social success. In contrast, social network analysis assumes that social connections, like roads leading to particular destinations, allow individuals to gain access to social capital in the form of information, values, discourse, and supportive relationships with individuals who are agents of social entities (Bourdieu, 1977). The foundation for network analysis is Wellman's (1983) concept of a "social distribution of possibilities" which states that individuals have unequal access to agents who control institutional resources (cited by Stanton-Salazar, 1997).

Factors external to schools affect access to education and the middle class social capital controlled by schools. Low income, minority families may not be able to keep their children in school even though they recognize that successful school socialization is a gateway to mainstream economic and political resources. Even more problematic, the social worlds such families inhabit are less likely to provide their children with the cultural capital of knowledge, standard English, and mainstream values that ease access to schools. If social networks do not permit equal access to the cultural capital of schools, class mobility is reduced.

According to Wellman's notion of a "social distribution of possibilities", the four racial minority women in this study would be unlikely candidates to develop into civil and mechanical engineers. Only one came from a middle class, nuclear, English-speaking family. All suffered from negative racial stereotypes, holdovers from Hawaii's plantation past, that portrayed Polynesians and Filipinos as socially and academically inferior (Porteus, 1962; Stueber, 1964). In their public and private schools, selection processes such as academic tracking and teacher recommendations ensured that students were sorted by test scores, linguistic ability, and behavior. Peers who shared their Polynesian/Filipino ethnicities were under represented in college preparatory mathematics and science classes and over represented in special and

vocational education classes (1)(Haas, 1992). In their engineering programs, they lacked both ethnic and gender role models.

It is hoped that their narratives of their educational journeys provide mainstream educators with maps of the invisible cultural terrain that class/race/gender/linguistic minority youths must navigate in order to enter and succeed in the unfamiliar world of schools, school science, and non-traditional careers.

Purpose of the Study

This study was undertaken to gain a deeper understanding of factors that affect minority individuals' decisions to enter the historically Eurocentric, masculine domain of science and engineering (Jacob, 1988). In this study, the four women of Polynesian and Filipino ethnicity represent groups that are conspicuous by their absence from the science and engineering literature. As path breakers, they would likely be more affected and thus more aware of cultural factors that are detrimental to the entrance of ethnic and gender minority individuals into these fields.

Methodology

Since it is through language that a particular woman's place in a social matrix is understood by others and herself, a core of questions concerning childhood, family, school, peers, gender, ethnicity, identity, and career expectations became the starting point. Underlying the selection of the interview as the research methodology is the theory that personal narratives are a primary way for individuals to made meaning out of the events of their lives (Mishler, 1986a, 1986b; Sarbin, 1986; Polkinghorne, 1988; Linde, 1993).

A co-constructed, language oriented narrative methodology with its emphasis on intersubjectivity and co-constructed talk also fits feminist notions of interpreting an individual's location in a social matrix from a woman's standpoint (Devault, 1990). As a woman with a physical science background who had grown up in Hawai'i as these women had, I hoped to overcome potential social barriers of ethnicity, age, and my role as researcher. Through the intersubjective process of active listening and responding, I tried to understand each person and the social worlds she perceived herself to inhabit. Audiotaped interviews were completely transcribed and sections with responses to the core questions and comments concerning social identity were analyzed.

Narrative analysis of the roles played by key actors was guided by a social capital/social network perspective. Actors and their actions were weighed for the influence they had on shaping the women's identities and for the social capital middle (e.g., class knowledge, skills, attitudes, and behaviors) they transferred to the women.

The women were either in the final year of their engineering programs or in their first year of employment as engineers when interviewed. The four were evenly divided between civil and mechanical engineering.

Results

Hawaii's colonial, racist legacy lives on in the practices of its schools and pervasive attitudes towards race and language. In the four case studies that follow, the narratives of Polynesian and Filipino women engineers reveal the impacts of racial stereotyping: at home, in school, and in their relationships with peers. Further problematizing their choice to be engineers are cultural attitudes that associate mind, body, jobs, and job sites with gender: indoors vs. outdoors, protected vs. exposed, clean vs. dirty, social science vs. "hard" science, soft, feminine vs. "hard" masculine body.

Though each woman had a unique life story, certain common themes emerged, such as the family as a workshop in which a primary social identity was constructed. From this common ground, how each component (e.g., gender, ethnicity, culture, and class) of a woman's identity intersected with schooling and career reveals the complex and subtle effects of power and ideology on minorities in America. Stories in which they related the words of more powerful others as determinants for their thoughts and actions support Bakhtin's (1986) notion that the internalization of "speech genres" (language used in different spheres of social activity) is fundamental to a person's ideological formation.

This conceptualization of identity being inculcated instead of originating with the individual shares much with Bourdieu's (1977) concept of *habitus*, a durable, inculcated body of cultural knowledge/ideology/values, and Althusser's (1971) concept of *interpellation* in which a social subject is created by assigning individuals into pre-existing social categories. These theorists present a view that is in direct contrast to western European and North American notions about the processes by which individuals develop. The western world's Enlightenment individual who has direct, sensory access to reality, one who is an "autonomous, rational entity and the epicenter of meaning" (Gardiner, p. 86, 1992) is displaced by a social subject who exists in a dialogical/ideological relationship with other socially constituted others.

Protective Agents: Supporting Successful School Socialization

For young children, parents, relatives, and friends provide the supportive social network in which children begin to develop their early understandings of self-worth, abilities, and interests. What might be considered childish actions, inconsequential games, and unremarkable family activities were recalled by the women as contributing to their early interests in science and math. Certain attitudes, values, and interests learned from protective agents made for a relatively unproblematic transfer to formal school settings.

Malia, a mechanical engineer whose known ethnicities are Filipino, Hawaiian, and Chinese related that her mother, a nurse, and stepfather, an electrician, valued education greatly and provided a head start in literacy activities. Malia and her older sister, a pharmacy student, were exposed to reading, tinkering with tools, and science at an early age. Like all the women interviewed, she "liked to take things apart and put them together" and recalled that her stepfather would "show us how to work the instruments, the equipment. So we knew how to put it together. We could do it on our own."

Malia remembers being introduced to reading, arithmetic, and science by her mother:

> (T)he way I learned to read,...my mom used to read to us....That kind of made it important...it got me interested in science, too...because you read about NASA....She used to buy us books and sometimes we would go to the library. But each night...she'd read us a story before we would go to sleep. I think that was important because my friends now, some of them don't even like to read. And I tell them it's enjoyable!....(M)y mom also used to subscribe to this kid's magazine that had a lot of science...English and some art.

Rosa, born in the Philippines to a surveyor father and accountant mother, recalled that her earliest memory at the age of four linked writing with her parents' careers: "I wrote my name with a pencil, Rosa, and then I was happy. And I was on top of my dad's drafting desk, my mother was behind me....So I had two choices, becoming an accountant or an engineer." But seeing that all her father's coworkers were men led her to assume that only males became engineers. Meeting her godmother, an engineer, was a revelation. She recalls thinking, "Oh, a girl can!...That's what I want!"

Cori, a Hawaiian-Japanese mechanical engineer, credited her father, a professional diver at an ocean research facility with exposing her very early to mathematics and science. Though he never directly encouraged her to enter science or engineering, his stories about engineer colleagues made a lasting, positive impression. He had high academic expectations for

his two daughters and was always available to help with homework. Mathematics was a game her father played with her and her older sister, who holds a mathematics degree: "We'd go to the movies and we'd be standing in line and he'd run off a whole bunch of numbers...and we'd have to spit out the answers. And we loved that. That was our mind game."

Beatrice, a civil engineer, was the fourth of five children born to parents who immigrated from Samoa and the Philippines. Her father, a stevedore and sugar plantation laborer, and mother, a waitress, sent all their children to public schools except for Beatrice. They made great financial sacrifices to send her to a church denominated, girls' preparatory academy after her older sister noticed Beatrice's academic success and suggested a private secondary school instead of the public one she had attended.

> (My parents) would wake me up early and take me to school, pick me up. So they'd would always encourage me, 'Try your best!' Both of them!....They paid for both high school and college. They had to take out loans each year because it was expensive.

The church denominated school was selective, with an ethnic and class distribution different from the high school she would have attended. The school positions itself as providing an academic environment that encourages girls to develop their individual potential. Beatrice's junior and senior science projects were selected for the state Science and Engineering Fair. Six years at a school that sent over 90% of graduates to college provided her with a social identity that enabled her to reject painful, negative stereotypes:

> I've heard the--you know, like other people tell me, oh, this and that , you know, about stereotypical Samoans and Filipinos. But, you know, I don't pay attention to that. In fact, my best friends in school were Japanese girls, Caucasian girls.

When Beatrice received her civil engineering degree, she became the first in her family to complete college.

Constructing Gender, Ethnic, Academic Identities

If parents represented groups that differed greatly in social ranking, they could present their children with contradictory, potentially disabling messages about gender, ethnicity, and class. Cori thinks her Japanese mother and Hawaiian father each favored a child with significant outcomes in gender identity and gender behaviors. She showed me a family photograph to illustrate her point. She was tanned, had long hair, and wore little makeup while her fairer skinned sister used makeup and styled her short hair. Her point was made: "I took after my father and my sister took after my mother. I was like my father's tail. I remember I always wanted to be his son...The two of us would do everything together."

Cori's comments about how her family dealt with race and ethnicity issues reveals how constructing a personal and social identity also incorporates power relationships:

> I think in our house, the Japanese culture was stressed...my father, though he's Hawaiian really identifies with the Japanese culture....He's learning the language now, in fact. I remember once I asked him, "Could I take Hawaiian instead of Japanese?" And he said, "No, because Japan is the culture that seems to be taking over...to be successful, especially in engineering, you need to be able to speak and understand the Japanese people.

In a twist on the contrasting stereotypes of hard-working, educated Japanese vs. lazy, uneducated Hawaiian, Cori credited her father with the success of her mother's business and believed he would run it much more efficiently. Cori dismissed her mother's influence on her intellectual and social development, "I don't want to insult my mother, but my father was the main one.....Education to him was extremely important. My mother was more, umm, I guess she just took care of us." When I exclaimed, "Your *mom* is pure Japanese?!" Cori laughed and replied, "It's really funny. It's really opposite with them." Cori's laughter indicated she

perhaps intended to expose my hidden assumptions about race and culture. Her father's stories had taught her about white racism; now she learned strategies relevant to Hawai'i, where Japanese controlled access to most economic resources and political power.

If Cori's professional identity was Japanese, her personal identity was Hawaiian. "I tend to think I identify with the Hawaiian culture and my sister more with the Japanese. I guess, umm, I have a hard time with the Japanese culture in that they don't show emotion. That's one thing I have a hard time relating with." She described her Hawaiian side as a "troublemaker", that is, emotional, loving, undisciplined. She said about her sister, "She's the feminine one, I'm--I don't know. Opposite of feminine." She recognized that the stories she told revealed a fragmented identity. Identifying with her father, associating with him, and learning from him to value Japanese ways may have eased her entry into the masculine world of mathematics, science, and engineering but resulted in a deeply felt alienation from women and ways she considers "feminine".

School Socialization: Tracking, Cliques, and Racism

Malia attended four public elementary schools that served distinctly different ethnic and socioeconomic communities. The first, near two military bases, was 50% white with significant numbers of black students. The second was 40% Japanese and 20% white. The third enrolled children from local working class and Filipino families. The fourth enrolled children from middle class local and Mainland families living in a new suburb.

Malia recalled that "being exposed to a lot of races made a difference". When she moved to her third school, the students teased her, saying she talked like a *haole* (white person from the continental US). Her teachers put her among "rowdy" students who looked like her, so that she would be a role model. She critiqued these early years and blamed teachers and schools for condoning academic and behavioral grouping that led to the formation of ethnically distinct cliques. She saw negative outcomes of labeling and low expectations among her peers:

> I was a really quiet student in class. It was interesting, though, because I used to be always put by the rowdy students....The smarter students would say, "Don't talk to them, because they're rowdy and stuff". But I would tell them, "If you get to know them, they're really nice! It's like, you just have to give them a chance!"....It started being cliquish about fifth grade, sixth grade...because the students were separated into groups, you know, by the teachers....It's like you're in this group, and (then) you're put in this other group and you're categorized. And I think that kind of helped make it cliquish, too, because you hung around the same students who aimed high....You did different work because you're categorized according to your level.

Malia talked frankly about the racism she experienced in school, especially in high school, where most of her classmates and teachers in college preparatory classes were Japanese. A teacher's question, "How do you know such proper English?" implied that students like her were not expected to speak well, and a Japanese classmate answered her innocent question with a racist remark:

> It was before class, and a friend...saw a paper on the chair in front of me. I said, "Oh, whose paper is that?" He looked at it...and said, "Oh, some dumb Hawaiian". I said, "Excuse me?!!" And he knew I was part Hawaiian and he goes, "Oh, I didn't mean that."

During her senior year a Hawaiian-Japanese teacher took her aside to confide, "'I know what you're going through, Malia.' She was impressed that (pause) I was in a pretty high level class...She was telling me, 'Don't listen to them'...and she encouraged me." For Malia and her part-Hawaiian teacher, the price of academic success was social isolation, the feeling of being always a visitor, never a member of groups delineated by ethnicity, class, and academic background. Malia spoke slowly and thoughtfully of those difficult times:

> I'm kind of weird...I didn't have a clique. I was like, a "visitor"....Most of ___ School was Japanese. Sometimes it made me feel uncomfortable. Peer group, little things, little snide remarks....I mostly hung around the people in my class because I didn't really fit in with the upper group and I didn't really fit in with the locals....It was weird because a lot of, some of my friends were in the upper (group), you know, the preppy kind. They looked down on my friends who were in the other groups...if I were hanging around one person, they wouldn't come near me....But other classes, like everybody would have to take, I would have friends who were kind of considered the rowdy group. And it was interesting that I could be friends with them and still be friends with the smart group.

If she had not family members who provided positive role models for school and occupational success, Malia's negative school experiences could have derailed her from her academic path. Through the years Malia was in school, her mother studied to become a registered nurse and her stepfather and uncles, an architect and a draftsman, gave her an early understanding of technical occupations by displaying their work and discussing their jobs.

Malia's positive school experiences centered on science and technology. She and a partner researched lasers for a science project. She was a member of the school's 1990 Solar Car team and helped design and build a road worthy photovoltaic vehicle. When I mentioned I had developed the program, she asked:

> Did it look like the Flintstone car? We helped construct it and...design it. It was fun, because I took drafting classes when I was in high school. The teacher was hard, (but fair) as long as you tried your best. (In college), I didn't have to take mechanical drawing because I took it in high school.

Malia learned early that groups could be categorized through speech as well as appearance. Her experiences in different schools and communities taught her to be sensitive to social milieu. Schools were places that valued standard English. Outside of school, pidgin English was important to fit in with family and friends:

> That's one thing that I learned, like when to turn off the pidgin--when to not use it and when to use it...I just kind of figured it out....There was some talk about it in class, but it wasn't like the whole class was taught about it....I had a classmate one time in my social studies class, and we had to do presentations each week on a news article. And the teacher would try to tell him, "Can you try to speak in proper English?" and he just couldn't....And he was Japanese, local boy Japanese.

Malia discussed language use and ethnic stereotypes with her college roommate and had a theory about causative factors:

> (C)ertain friends that I have....they'll say, 'No offense, but I don't like Filipinos because they act a certain way'. It's like they don't give each individual a chance. So it's like they're stereotyping each time. And I have some friends whose parents say, "Don't date so-and-so". I've noticed that the people who grew up here tend to do that. Because I think they grew up in cliques, they're more narrow. But I feel that people change--if they met a lot of different people, a lot of different cultures and stuff, they'd tend to be more open after that.

In college, Malia's high school physics classmate also entered mechanical engineering. Cori's and Malia's academic success proved that Hawaiians were not dumb, but that did not stop him from continuing to make ethnic slurs:

> (T)his past week, he ordered the equipment for our design project. And he says, (about) the sales person, because we wanted a discount, "Oh, the sales person, he's so Chinese!" I said, "Excuse me?!"....(Y)ou can tell there's some underlying racism or

discrimination, but it doesn't really bother me because he's pretty much a nice person. Except sometimes he can be annoying.

Malia spoke these last words slowly; his racism was indeed bothersome.

School Socialization: Sites of Dis/Empowering Narratives

After arriving from the Philippines, Rosa entered a public high school that served a working class community. She was placed in a low level math class even though she had already completed algebra but was soon transferred to a higher level class where she was invited to join the math team and encouraged to enter engineering. She received excellent grades, enrolled in college preparatory math and science classes, joined the track team, and was invited to submit her *vita* to a who's who publication of high school students:

> A lot of people recognized me and they encouraged me to do a lot of things....The teacher would say,"...(Y)ou have to take biology." I said, "No, I don't want to take biology. What else can I take?" "(R)egular chemistry or the advanced chemistry." I said, "Advanced"...."Sure you can handle? Go for it!"....I hadn't taken chemistry before, so that's why I was so excited to take that class, because that's something new. To me it's a challenge.

But Rosa's experiences at her public high school were not all positive, supporting Haas' (1992) findings that English as a Second Language (ESL) students are routinely placed in classes below their ability with teachers who are not ESL trained. She had problems with insensitive teachers and racial slurs from peers that could have led to fights:

> When I got into SLEP, I can't talk in English, but...I know what they're talking about, I just can't express myself. They're saying bad things like, "Ho, she's so stupid!"....even the teachers (said), "Take her around, she doesn't speak English. Go!" ....The teacher sometimes insults them, "You cannot understand this?!" I don't know if she understood the diversity in that room...When I went (into regular classes), that's when I went, "This is a challenge!" because I had to communicate with the local people....(T)hey're seeing me as a Filipino, they tease me....(T)hey're swearing at me and....they call me stupid and stuff....Like I said, I was on the bottom.

Muses and Majors: Gender/Dress/Job Performance

Initially, Rosa's thoughts of civil engineering versus accounting were associated with her desire to acquire a position that valorized femininity, beauty, intelligence, and talent. In colleges in the Philippines, a woman called a "muse" was competitively chosen to represent each major. In her experience, women only entered the indoor profession of electrical engineering. Thus, being a civil engineer, she would not need to compete to be the muse.

> I could be a (civil) engineer because I was the only girl, and I would be the muse....Because civil engineering is, to me, working outside, being under the sun, getting tanned, getting dark. But I don't mind that. I like that. I wanted to go outside....I went to a lot of (accounting) orientations, and--too much girls. And I don't like those--feminine kind stuff, clothes. They're so ladylike....I just can't handle this. I just feel the pressure of looking good everyday. And then gotta impress all the guys....I'd rather go into engineering and be myself.... So I said, "OK, I'll go engineering!" It's more challenging too, in a way. That's how I decided.

Rosa's evaluative comments about muses and majors reveal a decrease in the power of feminine/Filipino cultural expectations to define her appearance, behavior, and occupational choices. Rosa recognized dress and behavior as performative aspects of careers. Confident that she could succeed in either major, she chose the one that felt most comfortable. When I interviewed her, she was in her first year as a civil engineer working on a major highway job. She jogged, played on the company softball team, lifted weights, wore jeans and boots at the job site, fixed cars with her father, and wore dresses and high heels to church and the office.

While in college, Beatrice worked as a draftsperson and married a coworker who encouraged her to enter civil engineering. Though her mother noted that the work would be outdoors and dirty, Beatrice's only complaints concerned the program's impersonality, pace, and a climate of survival that fostered competition among students:

> One thing I learned was that you'd have to be aggressive on your own...you have to be competitive, you have to speak up, you have to put in your ideas....(I)n high school...I would ask questions (and) participate. But in college, I noticed that kind of changed."

Being elected to office in a student engineering society helped her grow comfortable with speaking out in class and to professors.

Cori had no complaints about her mechanical engineering program, "It's pretty neat because the guys tend to treat us like one of the guys and I really enjoy that". Cori's private school for ethnic Hawaiians and her father's efforts to raise disciplined, scholarly, physically strong, culturally Japanese daughters largely kept them from experiencing Butler's (1993) *realm of the abject*, the psycho-social space occupied by weak women and dumb Hawaiians. She only experienced being a minority when she entered engineering. An advisor exclaimed, "Wow, you're a true, living, breathing Hawaiian in engineering!" and her work as a peer counselor with young Hawaiians enabled her to witness the power of negative stereotypes.

But, for Cori, the positive aspects of being so accepted in a male-dominated professional world had a price. When she planned her wedding, she had only one woman friend, a classmate, for her bridal party. When she asked a close male engineer friend to be in her wedding party, he refused. She interpreted his refusal as gender confusion, "I guess he didn't want to be gay...or portray that image. (I said) 'But you're married! You have a child on the way!'" Her friend confessed that he viewed her as more male than female and blurted out, "The way you think is more like a guy". Cori was complimented. In contrast, it was her male friend who felt trapped in the abject, unthinkable position represented by the homosexual in homophobic America (Sedgwick, 1990; Butler, 1993).

Discussion

The women's narratives describe three principal strategies employed by parents and the women themselves to counteract the power of negative racial and gender discourses: mimicry, backtalk, and immersion. Whether intentional or unconscious, mimicry of the behavior and language of dominant social groups was a strategy that partially shielded these women from being categorized as the inferior other (Bhaba, 1994). Parents worked hard to teach their children reading, math, proper speech, and behaviors valued by middle class teachers. In Hawaii, lower status individuals can mimicking middle class whites or mimicking the more familiar middle class Japanese who constitute the dominant ethnic group and institutional agents in schools and local government. Malia's stories of being placed next to "rowdy" students to serve as a role model show she exhibited the compliant, attentive behaviors her teachers expected. Cory's story of being told by her Hawaiian father to learn Japanese instead of Hawaiian. Beatrice told me her younger brother was majoring in Japanese at his community college. Choosing the language and cultural ways of another is a strategy of assimilation.

But mimicry to erase differences was not the only strategy. Malia was not afraid to challenge individuals who claimed to be dominant. Malia refused to allow her Japanese classmate to interpellate her as a "dumb Hawaiian". Her talking back to him is a rejection of symbolic violence. But as a Filipino/Hawaiian woman, she remains a marginal member even as she acquires the social capital of an engineering degree. She is still socially less powerful than her "annoying" Japanese classmate though far more tolerant and insightful. Her strategies of back talk and retaining multiple affiliations exact a price--in each group, she feels a visitor, not a member.

A third strategy was to immerse the minority child in a middle class environment to shield her from demeaning racial and class interpellations and negative peer influences. Beatrice and Cori both attended selective, private schools. Beatrice's working class parents made great financial sacrifices to send her to a private school where she would be immersed in middle class school experiences that would provide the speech, behaviors, and ways of thinking that her parents and public school peers could not. Cori's middle class parents enrolled their daughters from kindergarten through high school in a select private school that only admitted ethnic Hawaiians. The girls learned to value both Japanese and Hawaiian cultures, but knew from their father that Japanese was far more important for success in middle class enterprises.

Gender and Engineering

An element of mimicry involves the performative aspects of gender. Judith Butler (1990) proposes that gender is a cultural fabrication, an illusion or fantasy that has no essential core but serves as a regulatory ideal with political implications. The power of this cultural arbitrary creates an image of the ideal man or woman which serves to regulate the behavior, thoughts, and desires of individuals. But if there is no way to become the ideal, then it is only through performance that gender can be expressed. Butler writes: "If gender consists of the social meanings that sex assumes, then sex does not accrue social meanings as additive properties but, rather, is replaced by the social meanings it takes on (Butler, 1993, p. 5). Cori's story of her male friend's distress about being her man/maid of honor demonstrates the materialization of the replacement of sex with the social meaning of gender. In his mind, Cori's female gender was transformed to the point she was perceived as a man, threatening his own sex/gender identity.

Performative acts and speech exercise what Butler calls a "binding power" (Butler, 1993). In an institutional context, performatives are authoritative: a performance is a reproduction of institutional conventions. The performer becomes the desired I = social identity as she responds to "being called, named, interpellated" (*ibid*, p. 225). Women seeking to enter science and engineering, historically a male domain, encounter what Bakhtin (1986)calls *speech genres*, the complex of knowledge, communication styles, and ideology which reflects the social history of the field. By default, science and engineering retain the images of powerful (mostly white) males and lingering images of frail, irrational women. Thus the ideology of science interpellates women into pre-existing masculine categories in opposition to the categories available to women. The internalization of contradictions is an example of the regulatory power of multiple hegemonies and competing cultural narratives.

A behavior seemingly as unproblematic as competitiveness illustrates the dilemma that exists for women, but not for men. American culture valorizes the individualism and competition. But men and women are permitted different arenas of competition. Rosa and Cori preferred the academic and athletic competition associated with males to the competition based on dress and attractiveness allowed to women. Even Beatrice, who appeared to me the most feminine of all spoke of having to adapt to a male dominated environment.

Malia recommended that women should form study groups with men to learn the way they thought and spoke. Most of the women said they had more friends that were male than female. All very physically active--running, lifting weignts, playing or coaching competitive sports. Physical conditioning, an important part of their identities as strong and independent individuals was often brought up in the context of resistance to gender stereotyping. For women who preferred the company and activities of males, this was simply an extension of their lives. These women thought about what they wore, and chose loose fitting clothes, simple hairstyles, a virtual absence of makeup, and physical fitness as signs of competence, seriousness, and male solidarity (Arthur, 1993). None wore a dress or skirt when interviewed, and was dressed for

her next stop, a gym workout. They hoped to send the message that their "hard" bodies were capable of doing the "hard" work required by "hard" science and engineering.

These women were so active and athletic as children they were given or gave themselves the label "tomboy". Sometimes, being boyish was a conscious act of resistance to being materialized as a girl; other times, boyishness was an act of identification with a father. In either case, it was a recognition that males as a dominant group allocated lower status and less freedom of action to girls. Conscious or not, gender mimicry could ease the entry of men into non-traditional fields because work itself is conceived to be gendered.

Weston's (1990) study of workers in skilled blue collar trades revealed that traits that managers believed were important to production were not gender neutral. Male employers' objections to women working in electronics, construction, and mechanics were grounded in cultural and biological terms. But Weston found that the realities of the job often did not require the masculine characteristics potential employers deemed important or necessary. Strength, toughness, and aggressiveness were not important when machinery did the heavy work and manual dexterity counted. A masculine workplace culture reinforced behaviors that were not only gendered, but potentially harmful; taking time to arrive at effective, safer, thoughtful solutions was perceived as effeminate.

Implications for Education: Speech Genres and Multiple Discourses

Bakhtin's concept of *speech genres* as the complex of ideology, language use, and behaviors embedded in specific social and historical contexts implies that everyone is exposed to multiple discourses through being part of or audience to diverse social groups. In contrast to the Foucauldian concept of the subject as "an infinitely malleable and contingent constellation of forces, a temporary nodal point in the endless flux of discourses and signifying processes", Bakhtin and his circle believed that human agency was possible (Gardiner, p. 75, 1992). Though an individual initially spoke through the speech genres of others, an awareness of the conflicts between and among speech genres could provide opportunities for individual agency and the construction of a personal history. Bakhtin believed that the "better a person understands the degree to which he is externally determined...the closer to home he comes to understanding and exercising his real freedom" (cited by Gardiner, p. 75).

A Bakhtinian, social capital perspective implies that children should have experiences that provide them with opportunities to learn and practice the speech genres of diverse groups. Althusser's assertion that ideologies have a material existence that constructs subjects suggests that social knowledges cannot be learned on an intellectual level, but need to be materialized through the characteristic practices of those groups (Althusser, 1970). Such educational practices imply that the areas of contestation of meaning that arise as non-traditional individuals enter a field are precisely those which should be consciously brought to awareness for discussion and evaluation.

The relevance of culture, gender, and ethnicity to success in school in general and science in particular would have been a radical notion not long ago. But the conception of all areas of human knowledge as socially constructed and ideologically shaped has increased the acceptance of constructivist approaches (Yager, 1991). Specifically, in the area of science and technology, schools can develop programs in which girls and boys participate in hands-on/minds-on, competitive/collaborative, indoor/outdoor, guided/exploratory activities that counter notions of gendered behavior. Programs that provide contact with women and minorities in non-traditional occupations provide students with concrete evidence they can use to challenge occupational stereotypes.

A major theme in these women's narratives is the critical role of family members in preparing them for academic success. Successful efforts by educators to involve families with school programs aligns protective agents and institutional agents in working towards the

common goal of the child's successful school socialization. Such efforts are especially important when children are in elementary grades, when attitudes towards learning and the child's identity as an academic success (or failure) are developing.

Clearly, teachers themselves must be aware of their central role as facilitators linking the social networks of families and communities to the middle class social networks of schools. If they themselves have not gone far enough in science and mathematics to be personally familiar with the speech genres of the field, it is even more important to bring those who do into the schools as partners in teaching and guides to future careers.

In a larger sense, these steps have the potential to democratize science and schooling. Inviting diverse voices, perspectives, and values into science can alter the conversation of what has often been a secretive circle of knowledge makers and political and economic power brokers (Fisher, 1990). As a group enlarges its boundaries to encompass greater diversity, its culture and ideology also evolve to incorporate the voices and values of its new members. Not to include discussions of gender, ideology, and power will continue the dominant discourses that construct science as an arena of knowledge and power from which women and minorities are excluded. Students will continue to think that women and men are essentially different and will remove themselves from fields which they perceive are meant for a particular sex.

More generally, the evidence from these women's narratives that personal experience of contradictory interpellations is a precursor to reflection and ideological critique is a finding that deserves further study. As our schools become increasingly populated by students who differ in ethnicity and class from mainstream teachers and administrators, it becomes critical that all educators have personally meaningful multicultural experiences that challenge even unconsciously held stereotypes and prejudices. Educators, as institutional agents who are primary gatekeepers to mainstream cultural capital, must be able to work successfully with diverse students, their families, and their communities.

Conclusion

The narratives of women entering science and engineering illustrate the ways that multiple, often contradictory ideologies of gender, identity, and power circulate through all aspects of social life. What helped these Polynesian/Filipino women enter careers which are non-traditional by gender and ethnicity are family members, who as protective agents, prepared their young children to be successful in a middle class world dominated by whites and Japanese. Rosa's earliest memories involve writing her name at her father's drafting desk. Malia and Cori told stories using tools at home to make things or take them apart. The women all came from families with working mothers. Parental involvement in literacy activities and organized sports encouraged the enjoyment of learning and physical activity.

For the most part, teachers continued the work of families. They provided the girls with the social capital, i.e., mainstream knowledges, that helped them excel in mathematics and science. Gifted and talented programs, college preparatory courses, science and technology projects, honor societies and the encouragement of advisors constructed a reinforcing cycle of high academic expectations, outstanding performance, and social recognition. The girls developed into self confident, academically talented students, who rejected hetero-normative gender roles that served as barriers to science and engineering.

But Malia and Rosa found that some teachers withheld social benefits and reproduced class and ethnic stereotypes by separating students into ability groupings. Teachers' and peers' racist comments and institutionalized ideologies of exclusion and difference triggered their angry critiques. Contradictory interpellations opened up the space for these two to define themselves as independent individuals without group affiliation. They personally knew middle class Polynesians and Filipinos who were cultured and highly educated. For these women,

contested sites where dominant discourses overlap and contradict each other provided an uncomfortable no (wo)man's land where, through reflection and critique, they defined themselves as individuals (Gardiner, 1992). Their own experiences showed that notion of an ideal individual, such as the ideal student, was itself a cultural construction that enabled power to circulate and dominate some groups at the expense of others (Althusser, 1970).

These women's narratives support the Bakhtinian conception of speech genres with the corollary of reflection leading potentially to individual agency. Where women challenged dominant discourses of gender and patriarchy, they constructed their own foundations of self and agency and became the authors of their own life stories. Malia, Rosa, and Beatrice, who struggled against the power invested in institutions and their agents, end with stories of self determination. By resisting and rejecting one or more dominant discourses and constructing their own ideological systems, they became cultural critics.

It seems that refusing to be interpellated as a girl, refusing to be compliant, and wanting to do things boys do is important to becoming an engineer. These women survived the entry process into the masculinized engineering community, but they paid a price. These women all told stories of psychological oppression, the feeling of inferiority that arises from sexism, racism, and cultural domination (Bartky, 1990). Even when a male did not seek to dominate, social events such as Cori's wedding highlight off-limit zones of sex/gender confusion and the difficulty of maintaining heterosexual friendships. Both Cori and her male friend had their range of individual options limited by following mainstream cultural conventions.

Institutional racism is a form of psychological oppression that reinforces negative class and ethnic stereotypes. Especially insidious are tracking practices that begin in the earliest grades. Educators who continue to categorize and label young children by behavior and norm-referenced test scores sort children into groups with unequal access to mainstream cultural capital. Such practices only allocate more scarce school resources to those who already have the most middle class cultural capital. Instead of being institutions that enable social mobility, schools become factories that reproduce social inequities. This clearly is an area that continues to need to be addressed, at colleges of education and through professional development programs for classroom teachers. Educators at all levels, but especially K-6, must recognize the crucial roles they play in connecting ethnic, class, and gender minority families and students to the mainstream networks of knowledge and institutional support controlled through schools.

Note

1. New England missionaries arriving in 1820 were shocked at female nudity, sexual freedom, and trade in arms and liquor for sandalwood (Porteus, 1962; Stueber, 1964). The first schools inculcated the missionaries' austere values as an antidote to a slothful, hedonistic native life-style. They established Punahou in 1841 for their own children to "offer the means of receiving an excellent English education under the best moral guidance, ...apart from the contaminating influence of ignorant and vicious natives" (Polynesian, July 3, 1841 cited by Stueber, 1964, p. 62). Hawaii's schools began as a vehicle for monoculturalism, "the practice of catering to the dominant or mainstream culture, providing second-class treatment or no special consideration at all to persons of nonmainstream cultures" (Haas, 1993, p. 161).

After the 1876 Reciprocity Treaty with the U.S. guaranteed a market for sugar, the white oligarchy sought "servile labor...(from) the lower strata of society, because it is cheap labor and because it is adapted to the tropics" (cited by Stueber, p. 130). In 1885 Reverend Bishop even proposed that Chinese and Hawaiians "being of similar social level" could produce offspring with better qualities than the parent races (p. 161, *ibid*). From 1924-1947 a spoken language test selected a small fraction of public school students for English standard schools, reproducing class divisions and restricting mainstream knowledge.

Recent ethnicity data indicate that about half of Hawaii's public schools are segregated, *i.e.*, school enrollment deviates over 20% from the ethnic enrollment in the district (Haas, 1992). Segregation is partially due to placing schools in plantation towns dominated by a particular ethnic group, while Hawaiian Homesteads are limited to persons of at least 50% Hawaiian. School policies exacerbate these problems by separating students into academic tracks that reflect class and ethnicity. Filipinos', Hawaiians', and other Pacific Islanders' standardized test scores decline from second to sixth grade, suggesting that "school experiences are responsible for lowering academic attainments of minority children" (*ibid*, p. 177).

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