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STUDENT ENGINEERS AND ENGINEER IDENTITY: CAMPUS ENGINEER IDENTITIES AS FIGURED WORLD

The research reported here contributes to understanding how student engineers on an engineering campus in the US mid-continent not only talked about the kinds of people recognized as engineers on campus, but also juxtaposes their talk about "campus engineer identities" with two students' ways of presenting themselves *as engineers* through engineering project teamwork to argue that campus engineer identities framed on-campus interpretations of actions, and ultimately that identity production was a complicated process through which campus engineer identities (cultural knowledge learned on campus) provided a lens of meaning through which to "recognize" (or not) performances of engineer selves *as engineers*. This research adds to conversations about identity in practice, especially identity production in science education, by suggesting the importance of cultural forms for belonging, especially at an obdurate site of science practice like the campus studied.

KEY WORDS: community of practice, ethnography, gender, identity, practice theory

INTRODUCTION

Most Americans have an image of engineers as "nerds": awkward men dressed unstylishly in plaid shirts and khaki pants, asocial technophiles who possess scientific knowledge, but aren't exactly scientists. But as I carried out three years of ethnographic fieldwork on an engineering campus (embedded in student teams as an engineering teammate), I heard student engineers use a much more complex array of terms to refer to one another as engineers. For instance, when James asked Eric how he did on a test, Eric's 93 (when the average was considerably lower) provoked James to say: "Curve-breaker." When Nate declined an invitation to grab a beer after a late-evening team meeting because he needed to study, Martin remarked: "Nerdboy." There seemed an endless list of such terms and I could not help but wonder about their status and meaning. They seemed far more than simply epithets or nicknames and, suspecting they were cultural knowledge about ways to act that conferred belonging in the campus culture, I explicitly studied them. Here, then, I will take an anthropological stance to argue that, at least on this campus, engineer identities were framed (given meaning or interpreted) by deep-seated sets of meaning (cultural knowledge about campus engineer identities) conveyed (learned) through participation in everyday practices. Thus, identity production was a complicated process that bound up *thinking about oneself as an engineer*, *performing*

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an engineer self, and ultimately *being thought of as an engineer*. Building on an identity conception consistent with activity theory, where identity is both product and byproduct of activity, as are relevant structures of the community where identity constructions occur (Roth et al., 2004), this article turns the research gaze away from individuals *as individuals* to focus on the relevant campus structures (cultural forms for engineer identity) against which student engineers thought about themselves and performed themselves *as engineers*. Thus, rather than assuming a "typical engineer" against which to juxtapose student engineer performances (enacted engineer selves), this article gives prominence to the particular cultural forms framing engineer identity on this campus. What I hope to argue is that there is something about this engineering campus, that sets it apart from identity constructions in K–12 science education and this "something" is a set of enculturated, complicated, profession- and site-specific ways to belong that encode ideologies of privilege, which in the long run made it very difficult indeed for some people to be themselves *as engineers*, or to have some of the selves students enacted thought of *as engineers* in spite of how their actions might otherwise display being an engineer.

IDENTITY IN PRACTICE

The study of campus engineer identity is long overdue. Rather than studying identity as a facet of campus cultures, cultural studies of engineering and engineering education have focused on the nature of engineering practice at work (Bucciarelli, 1994) or on campuses (Vincenti, 1990), the way a campus program "motivated" students to leave (Downey et al., 1993), women's historical presence in engineering (Canel et al., 2000), the movement of women to the margins in engineering companies (Mcllwee and Robinson, 1992), or students' reasons for leaving engineering education (Seymour and Hewitt, 1997). In fact, most took engineer identity as an unexamined given, which threatens to essentialize it.

However, some researchers suggest issues that must be taken into account. Talking about her experiences as a researcher in the guise of student engineer, one noted:

> In my stint as an engineering student [as a social science professor], performing participant observation I had tried to see some ways in which patriarchal ideology and practice managed to control young men's passions and loyalties today. I had learned that, in part, these patriarchal habits are often developed by the minutiae of everyday life, and that most all of us supported them by taking part, going along. As for me and the working-class and middle-class students learning to engineer, farm boys in the agribusiness classes, everything we learned to value, and the life-style we came to desire, the prestige, income and status over others, all

were perceived possible only by passing the tests. This daily experience required control of sensuality, the emotions, passion, one's physical rhythms . . . it is indeed inscribed on the body. (Hacker, 1989, p. 39)

That is, students embodied engineering practice in context. Further evidence of this came from ethnographic studies of computer science at Norwegian Universities. For instance, five central groups emerged on one campus: hackers, dedicated students, normal students, women, and professors/teachers (Rasmussen and Håpnes, 1991). Interactions with professors elevated dedicated students, while the other groups moved to the margins. Normal men and women groups shared an alternative to the dominant discourse on campus, but alliances between the two groups did not emerge and the university did not support developing these. Also, the social production of gender in an engineering context surfaced in another study of Norwegian engineers (Kvande, 1999). Here, women affiliated with one of four central femininities embodying different reactions to their engineering workplaces. Women affiliating with the femininity called "homeless" included recent graduates who assimilated to the usual practices as work, and more experienced women who did not feel like they fit. Women in the "one-of-the-boys" femininity wanted to be like their men colleagues and accentuated their similarities with men at work. Women in the "compensator" femininity group distanced themselves from the profession and found other things to occupy their lives. Women in the "challenger" femininities rejected and criticized aspects of engineering life and strove to change their workplaces, but on their terms. Thus, taken together, such studies suggest the importance of context at engineering sites of practice for understanding emerging ways of *identifying* with engineering and of *being identified* as an engineer.

Cultural production theory suggests a way to make sense of such contextual productions, and it is important to understand the interpretation of "culture" framing one's research (Eisenhart, 2001). The sense of culture I take is a way of thinking that began with Paul Willis' (1977) landmark study of working-class "lads" in a British secondary school, and his work guided studying how student engineers construe campus engineer identities. His line of thought grew out of anthropological research in learning settings that accounted for persons acting in cultural worlds, seeking to overcome the limitations of unconstrained agency (which could not account for societal, institutional, and cultural influences) and reproduction theory (which limited possibilities of agency). The study, among white youth in a mixed-ethnicity, progressive, middle-class-identified school serving an almost entirely working-class community, asked how working class boys working-class jobs (Willis, 1977). A group of young men intending to leave school as soon as they reached the leaving age, which had just risen to 16 years,

became the research focus. These self-termed "lads" rebelled against school authority via expressions of working-class masculinity-fighting, "havin' a laff" at teachers' expense, sexual prowess with "birds," and drinking and smoking – and rejected the behaviors of "ear'oles" – their classmates who affiliated with school practices, especially casting ear'oles as deficiently masculine and misguided. In time the lads' actions guaranteed their lack of school success and cemented their future in working class jobs. Thus, the lads' agency, while a form of resistance to the mainstream (UK) model of schooling that made little sense to them and seemed to offer false promises of a better life than the one their fathers knew, did not serve to change school practices, but instead to preserve them and the lad's place in them.

As such, the cultural level of day-to-day, go-to-school activities was constantly under production – where the lads were very active players, indeed – and the structural level of social class hierarchy penetrated into everyday social interactions (the cultural level) despite the school's progressive, liberal democratic ideals (at the institutional level). "The basis for, and impetus of, this [cultural] production is the informal social group and its collective energies . . ." (Willis, 1977, p. 173). Furthermore, identity formation was enculturated. "*Cultural forms* provide the material towards, and the immediate context of, the *construction of subjectivities and the confirmation of identity*. It provides what were the most believable and rewarding accounts for the individual, his future and especially for the expression of his/her vital energies. It seems to 'mark' and 'make sense' of things" (Willis, 1977, p. 173, italics added).

Cultural production theory continued to emerge through its use in a wide range of learning settings and identity's place in such studies became clearer. In a midwestern high school serving working- and middle-class students (Eckert, 1989), two central categories for belonging emerged: Jocks and Burnouts. Jocks encompassed those enrolled, sanctioned, and otherwise affiliated with the way of life school structures promoted, while Burnouts formed in opposition school structures. In a Texas border town high school (Foley, 1990), an array of terms for students in the school emerged and being termed, for instance, a jock, vato, band fag, cheerleader, kicker, good girl, or farm boy had clear implications about one's place in a social peer group order underpinned by race, class, and gender ideologies specific to the region. In both studies of high school life, terms students used to refer to themselves and their classmates suggest the existence of cultural forms for identity. Additional aspects of identity emerged via cultural production in communities on college campuses whether related to the production of a gender order (Holland and Eisenhart, 1992), an environmental biology identity (Eisenhart, 1996), or sexuality identities

(O'Conor, 1998). Ultimately, cultural production theorists conceived of identity as the link between the personal realm and collective understandings embedded in cultural forms and attendant social relations (Holland et al., 1998, p. 5). While cultural studies of learning settings thus documented the myriad ways that educational institutions serve as central sites where ideological histories feed into everyday cultural activities and impinge on individual subjectivity, rarely have site-specific cultural forms for identity been worked out with systematic research strategies in science education.[1]

In addition, some argued (e.g., Eisenhart et al., 1998; Levinson et al., 1996) that a cultural production perspective applies also to out-of-school learning settings. For instance, apprenticeships are one such social situation where identity constructions play out through a process termed "situated learning" (Lave and Wenger, 1991). Engaging a *practitioner identity* involved learning through participation; that is, novices strove toward becoming a mature practitioner while participating in community practices with old-timers. In cultural production theory, members of a community, one having social, cultural, and historical persistence, are shaped through their participation in communal activities, just as participants simultaneously shape their communities:

> [I]dentities are improvised – in the flow of activity within specific social situations – from the cultural resources at hand. Thus persons and, to a lesser extent, groups are caught in the tensions between past histories that have settled in them and the present discourses and images that attract them or somehow impinge on them. (Holland et al., 1998, p. 4)

Holland et al. termed such communities "figured worlds," contexts having their own sets of cultural resources – taken-for-granted ways of being, doing, and (I argue in Tonso, 1999) being "identified" as belonging there. Since so many people talk as if there were a kind of person termed "engineer," I began the ethnographic research wondering if such a leading identity existed and, if so, how it operated.

But, cultural forms for scientist can be seen narrowly, such as elite physicists (Traweek, 1988) or urban middle-school students' stereotypic descriptions of lab scientists (Rahm, 1998; Rahm and Charbonneau, 1997). A more nuanced scientist emerged in a conservation corporation workplace attractive to graduates from an environmental biology program (Eisenhart, 1996). The environmental biology program promoted a sense of scientist formed both within and against schooling, one that promoted connecting academic learning to the world of natural habitats and countered the hegemonic form of scientist aligned with laboratory or academic scientist. But, political and business demands at work countered the environmental

biologist formed at college. "Individuals respond to the structural alternatives, and as they do, they actively negotiate and sometimes contest the identities produced for them" (1996, p. 183). Or, especially in educational settings, "we can no longer conceive of social groups of people with a culture that is clearly bounded and determined, internally coherent, and uniformly meaningful" (Eisenhart, 2001, p. 17). Thus, cultural production theory:

> is much less willing to treat cultural discourses and practices of a group of people as indicative of one underlying logic or essence equally compelling to all members of the group. Instead, contest, struggle, and power have been brought to the foreground. The objects of cultural study are now particular, circumscribed, historically, and socially situated "texts" or "forms" and the processes through which they are negotiated, resisted, institutionalized, and internalized. As Foucault insisted, significantly for the study of culture and self, "cultural forms" are presumed to affect and shape subjectivity, and these cultural forms come in great variety. (Holland et al., 1998, p. 26)

A mediated sense of identity opened up the potential for socially constructed identities that are worked on, made explicit, or somehow manifested in context (Kondo, 1990), that is:

> Identities are our way of figuring the interfaces among these dimensions of collective life [figured worlds or collective frames of meaning, the politics of social positioning, and spaces of authoring]; our way of naming the places where our society organizes persons and persons in turn reorganize, albeit in modest steps, societies; the pivots of our lived worlds. (Holland et al., 1998, p. 287)

This led me to wonder about how student engineers performed themselves as engineers and what the campus community made of such performances.

Such a necessarily contingent, contextual, and culturally salient identity conceptualization differs centrally from understandings where "identities are person's internalizations of their role expectations" (Lee, 2002, p. 352), or a social identity where, as Lloyd and Duveen put it, "children are born into a particular society and become competent, functioning individuals with particular identities to the extent that they re-construct for themselves the social representations of the significant groups in their society" (quoted in Brickhouse et al., 2000, p. 444). If such a social identity conception of Brickhouse and others fits in science education, then I suspected that identity there differed from engineer identity at the engineering school. Thus, for the ethnographic research project from which this identity article is drawn, I began to wonder about comparisons and contrasts between the campus and other sites of scientific learning like K–12 education.

SITE AND METHODS

Public Engineering School (PES) in the US mid-continent typifies state-supported engineering programs, but like all colleges it differentiates itself from others. For instance, it is a stand-alone campus that attracts an extremely well qualified student body, all of whom graduate with engineering degrees. Some consider it an elite engineering school, an assessment rival campuses dispute. Nonetheless, it has a long tradition of producing engineers for a wide range of industry, government, and military employers. Speaking from my experiences as a former engineer (for 15 years) and from comments made by many contacts among engineers, engineering faculty, and women-in-science-and-engineering-program coordinators, the school is thought of as both demanding and set in its ways. In fact, students, faculty, and alumni take great pride in PES producing a certain toughness in its graduates, a sense that if you could survive the rigors of its program you could do just about anything, clearly promoting a certain form of masculinity. Though it has been co-educational for its entire history, dating to the 1800s, women became a routine feature of campus life only in 1970, when societal changes opened doors for women historically closed, and when the Vietnam War reduced the number of white young men usually enrolling at such engineering colleges. Like most engineering campuses, women were, and to a great degree still are, considered people who are welcome only to the extent they accept the way things have historically been done (Tonso, 1999).

Nonetheless, it was chosen because of having more women students (over 20% at the time of the study in the mid-1990s) and women faculty (11%) than national averages (18%, and 5%, respectively), a commitment to women's full inclusion, and a long-standing, reform-minded curriculum, called engineering design, that intended to emulate engineering practices similar to those of workplaces. My fifteen years in engineering and former professional connections to campus insiders helped me gain access. At PES, all students at the first-, second-, and fourth-year levels took courses where they worked in teams to complete a real-world engineering project for government and industry clients. As such, design courses explicitly suggested a campus tilting toward historically out-of-school engineering practices and, as a feminist with a keen sense of the obdurate nature of engineering culture and interested in engineering being more welcoming to women, I wondered to what extent design courses influenced the campus culture.

In a quasi-longitudinal approach during fieldwork from 1992–1996 (Tonso, 1993, 1997), I performed ethnographic research via participant observation as an engineering colleague on seven student teams (three at

the first-, two at the second-, and two at the fourth-year levels) and as a student in the three design classrooms (one-semester long at the first- and second-year levels, and two semesters at the senior level), and individually interviewed student teammates twice (15 women, 18 men students) and design faculty once (5 women, 6 men). I attended weekly one- to three-hour class meetings and almost all out-of-class team meetings, which ranged from an hour or two to as many as eight hours per week per team. I performed some engineering tasks, such as seeking help from experts, locating resources, doing engineering calculations, or writing/editing engineering reports, as well as giving advice or interpreting an event when asked to do so by teammates. However, I did not participate in (graded) oral presentations for faculty or clients. During team meetings and class sessions, I took extensive hand-written field notes that were later typed into a comprehensive account of each situation, taking care to record (to the extent possible) participants' exact language, their actions, and a description of the physical setting and artifacts used (Spradley, 1979, 1980). I developed an ethnography of each team and classroom using a Spradleyian analysis: a semantic domain analysis to follow patterns of sameness (and preserve meanings) in the data, a taxonomic analysis to determine connections within and among domains, and a componential analysis to locate patterns of difference. A constant comparative approach used repeated readings of the data to tease out competing interpretations (Glaser and Strauss, 1967).

Because I suspected that students possessed cultural knowledge about engineer identities enculturated on campus, and as part of the larger ethnography, I systematically unearthed identity terms, gathered information about what these terms meant to students, and probed how students organized these terms into categories for being engineers on campus. Eliciting categories of campus engineer identities followed a study of the cultural models behind Americans' talk about gender types (Holland and Skinner, 1987). Using a two-stage elicit-and-sort interview protocol, student engineers (6 women and 11 men, at first- and fourth-year levels) first listed "all of the terms you use to refer to each other as student engineers" and then described each term in their list. When all terms were described, I asked for terms that "referred only to women on this campus" and asked students to describe these. After eliciting terms, I made a comprehensive list of terms (from audio-tape transcripts). Seniors had substantially larger vocabularies than students from first-year teams, suggesting that terms were learned while on campus and that understanding the organization of terms would benefit most from what seniors could tell me.

Of the 126 terms given, 36 occurred more frequently in interviews and field notes and these terms comprised the sorting phase of the interview protocol (Table I). In the sorting stage, I asked senior student engineers

TABLE I
Most prevalent campus engineer identities

Nerds	Academic-achievers	Greeks (social-achievers)
Computer whiz	Anal	Betty[a,b]
Computer-nerd	Brown-noser	Big-man-on-campus (BMOC)
Dork	Curve-breaker	Follower
Dormie	Hard-core over-achiever	Frat boy
Enginerd	Hard-worker	Frat brother
Geek	Leader	Frat gut
Hacker	Over-achiever	Fraternity man
Loner	Studious	Greek
Nerd	Typical engineer	Jock
Nerdboy		PES-woman[a,b]
Squid		Slacker
Super-engineer nerd		Sorority chick[a,b]
Technogeek		Sorority girl[a,b]
		Sorority woman[a,b]

[a]Terms that refer to women.
[b]All others refer to men only.

(four women and seven men) to sort the most frequently elicited terms into "categories that make sense to you" and to "tell me why you put terms together in each group and to describe how the categories differ."

As part of the larger ethnography, the elicit-and-sort identity queries were included late in both student ethnographic interviews. For instance, in the first interview, I began with students' talking about what their team had been up to, conversed with them about "all of the places they met," or asked them to "help me understand how the distribution of teamwork is decided," and so on, until issues germane to observations or nascent interpretations had been covered, then segued into elicitation of the engineer identity terms and their meanings, and in the second interview into sorting activities. Since we had been teammates for at least half a semester and trusted one another, their comments describing the terms and their explanations of their organization of the terms did not pull any punches, as will become apparent when readers see that many gave noxious depictions of terms for women engineers, suspending completely their knowledge that as a woman engineer I might be (and indeed was) offended by their characterizations. During our conversation at the last interview, I asked team members to comment on where they would place each of their teammates among identity terms. I did not ask each student where s/he would place

her/himself, but depended on fieldwork case studies of each student (an enacted engineer self) to describe how each performed an engineer identity. I draw on two of these here.

Maps of campus engineer identities developed from paying attention to the number of times students put any two terms in the same category, that is, thought of them as affiliated. As detailed later, terms coalesced around three foci-different categories for belonging as an engineer, which fit together to form a stratified identity terrain. Students' descriptions of terms provided the characterizations of different identities and a thematic analysis of affiliated terms provided a sense of the campus culture's organizing principles for engineer identity.

In addition to these research strategies, I also studied campus curricular structures to ascertain the extent to which they constrained student life and surveyed students' perceptions of the differences between design and non-design engineering courses (274 students split almost evenly among design and non-design courses at first-year and senior levels, including women and men in proportions representative of campus populations).

Overall, the research project unearthed campus culture and gave it prominence. A thematic analysis across the three classroom and seven teamwork ethnographies, identity categories, and curricular structures and survey analyses provided a way to develop a sense of the larger campus culture – the way of life preferred, sanctioned, and otherwise promoted by the institution and made evident in individuals' actions. Curricular structures represent the macro side of the culture and teamwork ethnographies the micro side. Classroom ethnographies provided access to one central site where campus culture was made evident to students, that is where macro and micro connected. However, campus engineer identity categories, especially the ways in which students organized them, made clear the ideologies underpinning hierarchical power relations (Tonso, 1999) and provided a way of understanding how campus culture became embodied in students.

Rigor was thus built into the research plan using Lincoln and Guba's (1985) notion of trustworthiness: credibility, transferability, dependability, and confirmability. Credibility speaks to the truth value of the research, which is improved through prolonged engagement to become part of the scene and minimize disrupting it, persistent observation to be sure that what is seen is a common occurrence, peer review, member checks, negative case analysis, and triangulation of theories, methods, and sources. Prolonged engagement and persistent observation were met by attending all class and teamwork sessions for each team. In fact, for each course followed, fieldwork reconnaissance commenced for an entire semester before the course studied as a way to acclimate to each setting. In addition, a senior ethnographer provided oversight and advice during the study and the work

has been recognized with national awards for excellence (one of them in qualitative methods), suggesting that the demands of peer review have been met. Member checks came both during fieldwork informal interviews and specific interview questions in formal interviews probed participants' sense of emerging interpretations – and after leaving the field – having members of the community read drafts of, and provide substantive comments on, the original ethnographies (Tonso, 1993, 1997). The complicated quilt of research theories guiding the work, methodological traditions, and rich data sources from across the cultural terrain met triangulation criteria.

Once credibility can be established, transferability, dependability, and confirmability are gauged. Transferability, which is analogous to external validity for statistical research, refers to the extent to which findings from one research study might prove applicable to another site. This is something that only the reader can ascertain, which requires the writer to provide rich descriptive accounts from which the reader can make judgments. Dependability and confirmability rest on a well-qualified researcher being able to follow the research process from hand-written interview and field notes to finalized data to analysis worksheets to data citations in the text. For the research reported here, confirmability and dependability criteria were met during research audits for the original ethnographies (Tonso, 1993, 1997). Finally neutrality was maintained by keeping a research journal where (1) nascent interpretations, conjectures, and emerging findings could be noted and later checked through fieldwork or member checks; (2) a sense of the site's impact on me was written about and reflected upon; and (3) changes to the method could be noted.

This paper, then, concerns itself with identity production and begins with an explication of students' cultural knowledge about engineer identities on this campus, then takes up how two students performed engineer selves, and finally returns to the issue of identity production on campus and how this campus differs from other sites of scientific learning, in particular asking:

- How do student engineers make sense of being an "engineer" on their campus?
- How do individuals perform themselves as engineers and what does the campus community make of such performances?
- To what extent does this engineering campus parallel other sites of scientific learning like K–12 education?

NERDS AND OVER-ACHIEVERS

Campus engineer identities represent how students talked about different ways to be recognized as an engineer via institutionalized routines, and

ways for students to characterize others as engineers on campus. Campus engineer identities coalesced around three foci: Nerd, Academic-Achiever, and Greek (or Social Achiever), though students referred collectively to Greeks and Academic-Achievers as Over-Achievers. This terminology signaled the lower status of those who fit into the Nerd category, and conversely the elevated status of Over-Achievers. Two other aspects of campus engineer identities also became clear: (1) students associated different forms of engineering practice with Nerds than with Over-Achievers, and (2) campus engineer identities seldom referred to women and when they did it was often in a pejorative way.[2] Let us begin with the Nerd category. Here, I provide substantial descriptive detail as a way to make clear the depth of meaning that each term carried, to indicate that these are far more than stereotypes or nicknames, and to allow researchers to compare engineer identities from this campus to those at other engineering campuses.

"We're All Nerds"

Many students started their recitation of terms by saying, "We're all nerds." Likewise, they were quick to help me understand that the campus use of the term "nerd" differed from that in the general population, which they thought stereotyped engineers. One young man described the stereotype for me:

> This summer we were camped out on this river and we were watching people tube down. They were inner-tubing by our campsite. I'm sitting there next to my uncle when I see this guy with a little hat on. You know kind of nerdy looking guy. The glasses. My uncle's like, "Hey, he looks like someone that goes to PES." And I said not necessarily. And when he [the nerdy looking guy] gets to the rapids in front of our campsite, he falls out of his tube and loses everything down the river.

Unlike this inept individual, "nerd" at PES was an encompassing way of life, "what everybody is trying to do, work a lot, and [take school] serious[ly]."

Figure 1 depicts the way that students organized campus engineer identities in the Nerd category. The salient feature of this figure is not the size of the oval used for each term, but the other terms that it overlaps, since overlapping ovals indicates affiliations between and among terms. Two terms appearing together in the same oval indicates that students used them almost interchangeably or in very close affiliation. Two ordering principles emerged from students' descriptions of Nerd campus engineer identities and in their rationales for including terms here (Figure 1). They measured terms first against a yardstick for social skills and interests (decreasing to the right), and second relative to fascination with computers (increasing

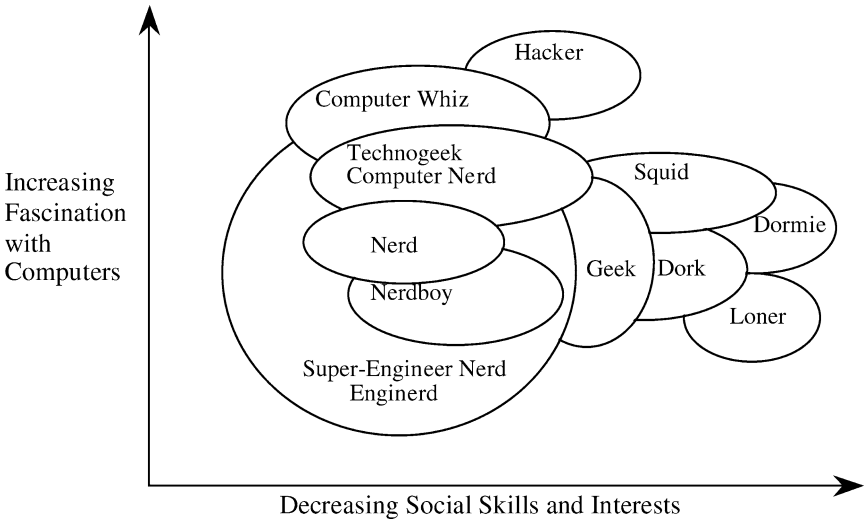

Figure 1. Nerd campus engineer identities

to the top), which in some cases resulted in increasing isolation from people.

"Nerd" is both the students' name for the category (when capitalized) and a term within it. According to students, the term "nerd" implied that "a normal person [here] is pretty abnormal [in the general population]," but not in the way non-engineers expect. According to student engineers, nerds are "intelligent, but have trouble conveying thoughts and ideas to other people." It is "not that bad to be a nerd, because nerd can be great. That's what everybody is trying to do, work a lot . . . and [take school] serious[ly]." Being a nerd and studying too much is an engineering school survival skill, because "school almost dictates that you study a lot in order to get your work done." This notion that school *almost dictates* what students must do to survive became a central theme of the overall research findings and, as the school's influence accrued over time, it carried enormous weight to influence strongly – but not necessarily compel – student behaviors.

Three other terms incorporated "nerd": enginerd, super-engineer nerd, and nerdboy, which one male student rendered (probably solely for my benefit) as "nerdboy or nerdgirl." As one student explained, "enginerd, super-engineer nerd, and nerdboy are affectionate terms. [These are the people that you] make fun of, but are glad they're here."

Enginerds can turn ordinary conversation into an engineering analysis, engaging a kind of engineering wordplay. For example, one student

told of a conversation he had with his older brother, a practicing engineer and alumnus of PES (suggesting one way these terms are propagated). A chewing gum advertisement came on the television and "we started talking about the half-life of gum [when half the flavor is gone] and the natural log of two over tau [something like the equation used in half-life calculations]."

Super-engineer nerd referred to students who excel at combining real-world practical knowledge with technical and scientific principles. "[They] figure out the theory and the math behind it and you've already got all the practical knowledge, so he could build just about anything . . . I would have classified [one student I knew] as a super-engineer nerd, because he read technical manuals for fun and had catalogs of resistors by his night stand."

Nerdboy refers to a friend who is on the verge of over-studying, of crossing the line from studying a lot to studying too much. One student was called nerdboy because "he knew all about H-P calculators and computers, [was] good with AutoCAD [a computer-aided drafting program], and got a 98 on an exam."

In the Nerd category, appending the term "nerd" operated in two ways. First, being "nerd-like" implied separating from non-engineers, a way of claiming affiliation with engineering. Second, among engineering students, campus engineer identities that incorporated "nerd" regulated within-group behaviors. Student engineers gave their colleagues not-so-subtle feedback on their behaviors by reference to less-than-desirable identity terms. Whenever a student made a bonehead mistake, colleagues said, "You nerd," implying his skill was suspect.

Moving toward the top of Figure 1 indicates increasing fascination with computers. Most students on engineering campuses are adept computer users; those who exceed that norm get special names: computer-nerd, technogeek, computer whiz, and hacker. *Computer-nerds* "socialize with their computers." "All they do is sit in front of the computer. They don't have a social life; they don't interact with people; they're just trying to debug the next program; they're trying to come up with another language. [It] makes no sense to any other individual." By comparison, *technogeeks* are not considered social outcasts, but they are thought of as people who "know all the facts about anything: cars, computers, new inventions." By adding the "geeks" suffix, student engineers signal an over-zealous collection, and often unwanted dissemination, of trivial technical information.

Computer whiz is "a term of respect for someone who's gifted with computers," but whose computer expertise has not resulted in isolation from other people. "When it's sunny outside, they'd rather be inside hacking their computer, but these are the people you go to when your computer has a virus." Having a computer whiz on your team means having an especially

knowledgeable computer user who enjoys helping solve problems that are beyond the skills of most students. Unlike other cultural identities among the Nerds and Academic-Achievers, computer whiz incorporated an integral component of service to others. In contrast, *hacker* referred to student engineers who are "gifted at computers and [are] pushing the boundaries of computer technology [sometimes finding holes in surveillance and security software by unauthorized entry to computers] and some are destructive-minded." Being a computer whiz implied using prodigious computer skills to succeed academically and to fit into the engineering community, but hackers' increasingly sophisticated computer knowledge served to bypass academically successful endeavors, risking a one-way ticket out of engineering college.

Derogatory terms signal declining social skills. *Squids*, students who study too much and do so in a certain area of the library (a public place where one cannot talk, snack, or be interrupted easily), are "nerds of the nerds, chained to their desks, who perform well in school," "but have to work at it." They "are studious to the point of absurdity and . . . may not be effective [studiers]." *Geeks* "lack social skills and the ability to communicate with others. If they know all about the Internet, [they know about] nothing else." These are the people "who sit in the front of classes and want to look smart by asking teachers questions that either they already know the answer to or the answer is not important." *Dorks* are the true social outcasts among student engineers. "They don't fit in and are obnoxious," "somebody that's annoying and bothers you." Where nerds, squids, and geeks are academically successful, dorks are less so. Finally, dormies and loners are even more asocial than dorks. *Dormies* live in the dorm, "have no desire to get out on their own" (an indication of immaturity), "are quiet and studious," and "have nothing better to do than watch TV" or "play computer games on Friday night." *Loners* are those students that no one knows because they are "not hugely social people and like to work in their room," implying they do not associate even with other dormies, much less socially active student engineers.

Students did not consider women people who fit in the Nerd category. As one of the more enlightened men students put it when talking about "the nerd-type profile. You know, the pocket protector. The nerd-type guys. . . . You don't think of women as that, I guess. 'Cause, at least at this school, I think guys here so much appreciate that a girl chose to come to this campus that you're just like, 'Great!' There are so many guys that you can say 'this guy's a nerd,' the pocket-protector-wearing guy." He seemed to have no way to talk about women's absence from the Nerd territory, nor did other men, and no one seemed to notice that some of their descriptions for Nerd terms fit their women design-project teammates.

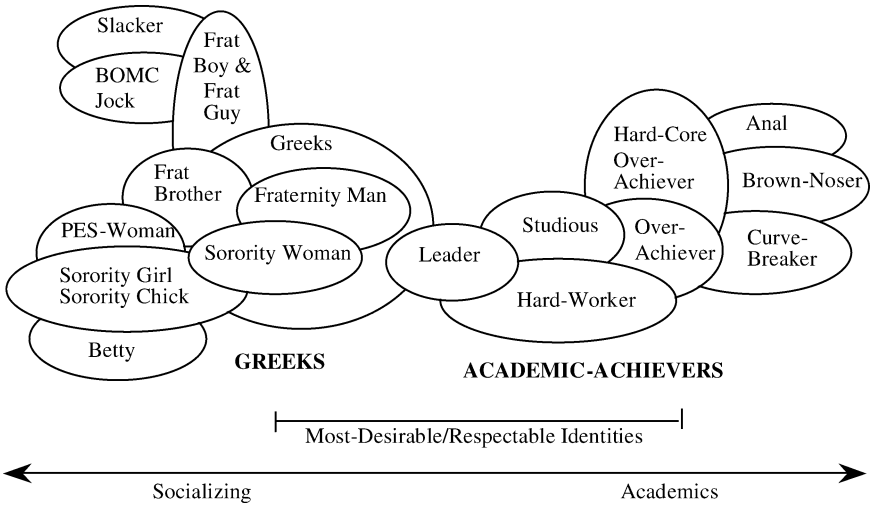

Figure 2. Over-achiever campus engineer identities

Over-Achievers: Academic-Achievers and Greeks

If Nerds were the underbelly of student life at PES, Over-Achievers encompassed the "movers and shakers." The term "leader" linked Academic-Achievers and Greeks into a collection of campus engineer identities with more status on campus than Nerds. Desired identities balanced academic work and socializing (near the center of Figure 2), less desirable ways to belong inferred losing that balance, while especially undesirable identities implied obnoxious behaviors, those who went too far (on Figure 2 up and to the right among Academic-Achievers or up and to the left among Greeks).

Academic-Achievers (the right-hand side of Figure 2) are student engineers who, in a variety of ways, more than "get the job done." Students organized the Academic-Achiever category in terms of increasing importance of academic work. That is, identities here flow with students' meeting academic criteria for success, indicating strong affiliations with the institution's preferred way of life.

Some terms were very respectful: *hard-worker*, *studious*, *leader*, and (for seven of the 11 senior student engineers) *typical engineer*. This area of the Academic-Achiever terrain is "what's good about engineering," the "real doers," "who put in the right amount of effort." As with Holland and Skinner's informants, student engineers accepted these "good" identities almost without comment and spoke about the organization of cultural knowledge of campus engineer identities relative to a set of scenarios in

which desirable identities were the yardstick against which less desirable identities were measured.

Typical engineer, though used on campus, seemed different from other terms. Four student engineers set the typical engineer card to the side and explained that it did not belong in any of their categories, simultaneously commenting that "there isn't a typical engineer" or that "typical engineer doesn't have meaning for me." Other students included "typical engineer" in a small category. One student explained that typical engineer did not fit in any of his categories, but described what one might be. "I don't know if there is a typical engineer. When I think of that, it's like the person out there he knows, he or she knows, the basic physical operations of things, knows how to get a job done. When something breaks, they know how to fix it and different things like [that]. Some people may lump into the typical engineer [that he] doesn't know how to spell or he can't communicate, but I don't think so. I think in order to be a good engineer you have to have all that. I think a typical engineer probably knows how to communicate very well." Yet, no one knew a typical engineer, making it seem like a mythic persona that transcended the mundane.

Those putting in more effort to succeed academically included *over-achievers* who "get high grades on all their tests, do all the homework, and get all A's, plus they work, play sports, and [still have time to] go down to the bar for a beer." "[On project teams] they out-do others, are over-productive, overshadow the group, and assume other people's work [without asking]." They are "grade-hungry, too worried about grades, and involved over their heads, [such as] taking 25 hours [of coursework a semester]," but are not viewed as having gone too far. *Curve-breakers* are on the verge of going too far. Even though almost no professors currently grade on a curve (allot grades according to a bell curve distribution), the term persists and means a "person who gets a 90 on a test when the average was 58 [out of 100]." Calling someone a curve-breaker is a "combination of envy and spite." "Some [curve-breakers] are pretty good guys and others are so out there."

Other terms denote going too far. *Hard-core over-achievers* "stay up three nights in a row to write a natural language database [not a typical engineering application] . . . They obsess about it and get it done." "The way they feel about themselves [depends on] how they perform against other people. They go too far and grades mean everything. They lose sight of [the rest of] life and gear their happiness toward some type of number." Being termed a *brown-noser* was an unflattering assessment of students who get good grades by "put[ting] effort into [getting ahead] without opening the book," those who "don't work hard and always kiss up to the teachers." "They are selfish and worry about themselves over others." *Anal* student engineers "always have to overdo everything and take it too seriously.

They are workaholics and are addicted to working. They never miss class and never blow off homework." *Went-too-far* Academic-Achievers asserted their rightful place by using reverse-discrimination rhetoric to complain about women's "preferential" treatment. As among Nerds, terms for women were notably absent from Academic-Achievers, and only being studious and a hard-worker seemed available to women.

Greeks (the left-hand side of Figure 2) socialize more (relative to Academic-Achievers) and students talked as if socializing more meant inherently studying less, though this should not be taken to mean that Greeks were not worried about their grades. In fact, they had ways to attend to their grades that bordered on cheating, for some. Unlike among Academic-Achievers and Nerds, the Greek category contains gender-marked terms and some refer explicitly to women.

Respected identities included *frat brother*, *fraternity man*, *sorority woman*, and *greek*, for which students gave almost no explanations, but these desirable identities were the yardstick against which other identities were measured. However, Greeks and non-Greeks had different views on the desirability of affiliating here. For sorority and fraternity members, *greeks* were "those who are more idealistic, [whose] ideals are based on the ideals of a fraternity or sorority," those with "outgoing personalities [who] take leadership positions on campus," who were "active in student government and running the campus." Among non-Greeks, greek was used in less respectful terms to indicate those who "buy friends," or are "just being involved so they can put it on their resume," while sororities and fraternities were considered "rent-a-friend agencies."

Less-desirable identities included frat boy, frat guy, sorority chick, sorority girl, BMOC (an acronym used interchangeably with big-man-on-campus), jock, slacker, betty, and PES-woman. *Frat boys* and *frat guys* connote men's identities disapproved of by most student engineers, young men who "drink a lot and smoke [presumably marijuana] a lot," "are very competitive [in intramural sports where fraternities field teams], hate those in other fraternities, and are only liked by high school students, freshman girls, and themselves."

By socializing more, fraternity members had less time to attend to their academic work and compensated by cutting corners:

> There's more of an incidence with the fraternities where they have the file [for a particular class] that everybody [in the fraternity] who's ever taken the class has their test in there. [If you are in that fraternity], you can go back and look at that. These are the people who do whatever they need to do to get around the requirements, [especially using a variety of ways of not doing their own homework]. They will spike [and some said "cold spike"] homework [copying it outright without any effort to understand it] and they'll all work together. Or they'll do a thing

where three guys in the fraternity are in this one class and they have the homework assignment with three problems on it, so they each do one and then spike around [copy one another's answers after taking a cursory look at the solution]. The next level up [is] cooperate-to-graduate [understanding another person's work thoroughly before you copy it and turn it in].

The fraternity files at PES were legendary and only available to members, which served to exacerbate the divide between Greeks and both Nerds and Academic-Achievers.

According to student engineers, *sorority chicks* and *sorority girls* were "not as bad as frat guys, because they're girls and not guys and guys tend to get bigger egos." Nonetheless, sorority chicks were "always with their group of girls and a little giggly" and seemed "stuck up and snobby." There was no talk about sorority members taking shortcuts to complete classroom assignments.

Most students on this campus, including many athletes, were highly motivated academically. Being a *jock* or *BMOC* delineated those student athletes exhibiting disreputable behavior. "They're cocky, and think they're better than they are," "are wild and obnoxious, and like betties." "They are more casual [about doing their share of the teamwork], [tend to] go with the flow, and are short of time," making them a teamwork liability.

Though all engineering students slack off occasionally to survive the pace and quantity of schoolwork, bona-fide *slackers* were at the extremes for over-socializing and under-studying. Slackers have "a different sense of urgency about homework" and "a nonchalant attitude," are "in cruise control" or "don't-care mode," "don't keep up, don't do the homework, go out and party all the time," "watch TV, and ditch class." They "are along for the ride," "let you do everything," and "figure they'll get taken care of." They were even more of a teamwork liability than were jocks and BMOCs.

Two terms on the margins of Greek life refer to women: betty and PES-woman. *Betty* means a "good-looking woman," a "cheerleader," "someone with high hair and lots of makeup." Four of the senior students had never heard the term betty. Other students implied betty was a sorority/fraternity "groupie," women invited to social functions because of their looks and not their membership in a sorority. *PES-woman*, when affiliated with terms among Greeks, is most closely linked to those who party too much: frat boy, frat guy, and sorority chick. In the Greek scene, it seemed to mean women who are "friends with people in sororities." However, on campus, it was most often used to denote the worst sort of woman student engineer, a gender epithet:

Big, easy, sluts [who] go to school here. If she's pretty, guys ask her out too much and, if she goes out with them, she bombs out of school because she doesn't study enough. [Hence,] the women who stay aren't pretty.

A big filing cabinet for sticking people [sic] into . . . [a] standard-issue stereotype [of women as] overweight, unattractive, and picky about men.

PES-woman encoded a timeworn trope for women engineers and scientists: physical attractiveness is inconsistent with the mental capabilities needed for maths and sciences.[3]

Invoking this mythic image of a woman engineer gave unequivocal messages that women do not, *and cannot*, be recognized *as engineers*, just as it signaled that a woman on this campus was always in the spotlight and anything she did would be noticed. In other words, women were hypervisible on campus, but were in time made invisible as members of the community (Tonso, 1999).

Comparing Nerd *with* Over-Achiever *categories*

Nerd and Over-Achiever domains reflected different forms of engineering practice: Nerds associated with using scientific and engineering principles to understand real-world situations, Academic-Achievers with doing only academic tasks graded by professors, and Greeks with graded products as well as being visible in campus-sponsored leadership positions. As such, the hierarchical relationship between Nerd and Over-Achiever categories encoded the prestige of performing well on timed-test tasks, especially manipulating decontextualized, mathematical abstractions central to academic science over the application of scientific knowledge to real-world engineering dilemmas. In other words, being an Over-Achiever embraced a hegemonic form of scientific practice, while being a Nerd countered it. However, in spite of not receiving *recognition* for manipulating abstract scientific and engineering principles encoded in mathematical equations, Nerds could do so with particular ease. In fact, Nerds understood such ideas far better than their higher status Over-Achiever colleagues. Thus, it was Nerds who could put scientific and engineering principles to work, while Over-Achievers seemed better able only to produce the appearance of skill with this form of engineering practice, and unable to demonstrate in a design-engineering context an understanding of scientific and engineering principles for which they were recognized elsewhere on campus.

Nerd and Academic-Achiever categories were perceived to be the rightful domain only of men. Thus, the terms students used to refer to one another as engineering practitioners also encoded women's systematic exclusion, except in Greek life, which embodied a form of womanhood based on normative heterosexual subordination. While not openly opposed to heteronormativity, per se, being limited to this version of womanhood, especially when it meant being reduced to being a man's companion and

valuable only to the extent to which one fell into a gender role subordinate to a man, was not attractive to many women student engineers, especially Marianne (Tonso, 1999).

Overall, then, students had stable ways of talking about those considered engineers – the kinds of people produced via engineering education. These represented students' ways of characterizing campus engineer identities, a set of understandings built up through everyday life on campus, contestations about what a "real" engineer is and what doing "real" engineering means. Students learned to take these terms for granted, to act as if they represented real flesh-and-blood people and documented set ways to be engineers. But were individuals' performances of engineer selves captured by these terms?

PERFORMING ENGINEER SELVES

Juxtaposing student's cultural knowledge about engineer identities with two students' performances of themselves as engineers, suggests not only how campus engineer identities framed performances, but also why innovative performances (those not recognized in campus engineer identities) had so little impact changing cultural practices on campus. Case studies of two senior student engineers prove illustrative. Marianne and Martin were teammates on a senior design team. Through two semesters of engineering work on their team, it became clear to me that they had remarkably similar capabilities and were excellent engineers who could not only work their way around the more theoretical aspects of engineering, but also possessed well-above-average abilities to match book-learning to real-world situations. Would the engineer selves they performed be adequately anticipated by terms for campus engineer identities?

Marianne's engineer performance

Marianne had a full range of opportunities to become an engineer and had done so. Her part-time campus job as a research assistant taught her about real-world technical issues and these experiences gave her technical skills that exceeded those of most senior students. This led to her being better prepared for their design work, as her summary of discussions between their client and a faculty consultant illustrates:

> I think they're talking about two different things [when they talk about maintenance issues]. The client [Curtis] is talking about new technologies. They [the manufacturing company] invested money to maintain this old equipment and then, when the new technology comes along they've got this perfect equipment that's completely outdated. So, the cost [to upgrade] is that much more; they have to

buy the new technology, plus they've spent all this money, keeping up the cost. Dr. Edison is talking about PCs [personal computers], and sensors, and predicting when it [the equipment being monitored] will fail.

In time, her teammates came to depend on her more and more, and their work could not proceed without her input. But, her job complicated her schedule, making it difficult for her to set aside as much time for team meetings as teammates on academic scholarships, but who were less adept at design work. When you added these demands on her time to her extensive social commitments to her romantic and family relationships, she always seemed to be running to catch up.

For instance, early in the second semester, the team met to discuss the design of the computer program they must develop to monitor pressure transducers. After watching portions of a video distributed with the software, Martin (the lead programmer) explained his ideas to the team. Students discussed his proposal and modified it. Marianne again linked the abstract realm of scientific/engineering principles and the real world of engineering projects:

We need to get a basic feel for the pumps [because] we want to compare it [the pump's performance under operating conditions] to the manufacturer's specifications. We want to set a high point and see how many times it [the pressure] goes over that. We want to have a counter, probably, so we'll see how high it'll spike on the pressure and see the relationship [between pressure and pump health].

While Martin continued to explain his ideas and answer questions, Marianne mentioned that she must loan her car to her fiancé, which will delay her getting to her homework until very late. But Martin needed her input and promised that she will be able to leave soon. When Martin described the revised system, his teammates agreed to the plan. Martin said, "I feel happier. I think I know what we need to be doing." Thus, on her team, she was a legitimate engineer, someone whose engineering expertise was valued and taken seriously. According to campus engineer identities, she seemed a shoe-in for being characterized as a Nerd, probably a super-engineer nerd, because of her heightened ability to make the connections between the academic realm and the real world.

Ultimately, Marianne's being deemed a bona fide engineer in the team did not carry over into her being considered that way in the design course, in other courses, or in on-campus employer recruitment of graduates. In fact, at the end of her senior year, she had no job offers, agreed to work for her department as a teaching assistant in the summer, and seemed likely to become a high school math teacher. Hers is an important example because so much research, hoping to ensure women's full participation in engineering, alleges that having access to faculty, learning about mechanical devices

and how they work, having opportunities to do real engineering, and being respected as an engineer will in fact result in women's being *recognized* for their engineering capabilities (e.g., Seymour and Hewitt, 1997). All of these factors were true for Marianne and she took great advantage of such opportunities, but recognition did not occur, which suggests the extent to which campus engineer identities encoded frames of reference and produced Marianne (and those who likewise fell outside the cultural forms) as "others."

Martin's Engineer Performance

Martin, too, performed an engineer self that countered campus preferences. Few outside the team knew Martin as a "star" student engineer because he was not visible to faculty and administration. He refused to exploit and control others, to act as if he were superior to women in normative heterosexual relations, or beat his own drum (especially not disclosing his high GPA). He generously shared his engineering work so teammates, whose job-search travel or fraternity and sorority duties interfered with teamwork, would have something to say during oral presentations to faculty and client. Most students considered him a computer whiz, but this was only the tip of a considerable iceberg of service to others.

For example, Martin emerged as a person promoting team cohesion (Tonso, 2000). A typical evening meeting meant students arrived at Martin's apartment as soon as they could after sorority/fraternity/committee meetings, work, intramural sports, etc., each with a snack they offered to share. Martin always had his stereo on and gave a running commentary on rock music. In fact, Martin used favorite snacks and music to promote team cohesion. For instance, while waiting to enter their faculty advisor's conference room, Martin asked about favorite rock songs, and he suggested other artists or songs that were similar. Later, meeting at his apartment, he had pre-programmed CD players to play our favorites and his suggestions. Once, in the power plant control room, where operators kept a radio on, he pointed out my favorite song to Nate several months after the original conversation, "introducing" us to one another through music tastes. Similarly, he capitalized on a conversation about potato-chip preferences by purchasing four varieties for his kitchen: sour cream and onion for Nate and Russell, reduced-fat for Jessica and Marianne, ripple for me, and plain for himself. Martin's awareness of his teammates' personal interests, a decidedly feminine behavior in U.S. society, was not celebrated in campus engineer identities.

Likewise, Martin's teamwork leadership countered PES norms. For instance, early in the course, the team hit a snag that threatened to derail

their project. The team discussed – with their client contact Curtis, and his boss, Charlie – the difficulties Marianne encountered trying to gain access to the manufacturing plant. Not having a project would delay a faculty-required report. Martin spoke about being less concerned with missing deadlines than with having something worthwhile to do, evidence of his Nerd-affiliated way of life. After Curtis and Charlie left the room, the team worried that they must start over. They sat silently around the table until Martin asked, "Reactions?" Team members commented in turn, expressing their frustration with business complexities and, with Martin's nudging, shifted gears and developed a project.

Martin embodied both counter-hegemonic leadership and prototypically feminine practices during teamwork. He was a leader who valued his colleagues, who listened to what others had to say, who encouraged them and reminded them of their commitment to performing high quality engineering matched to the real world, and who put engineering quality ahead of classroom-required products. This was not the kind of prototypically masculine leader that professors like Mason[4] (in sophomore design) and others recommended – a divide-and-conquer model where the leader cracked the whip and told teammates what to do; or that students tending to get the most recognition on campus demonstrated – doing very little themselves, telling others what to do, and later taking credit for that work. Martin also displayed prototypically feminine behaviors. He genuinely cared for his teammates and for their ideas. His ability to promote social cohesion via sharing such things as musical interests or potato-chip preferences rivaled that of a congenial hostess, something typically considered feminine in the US. He used the same model for sharing technical expertise, such as when he insisted that his teammates provide input as he developed the computer program for monitoring the sludge pumps.

However, Martin's prototypically-feminine/counterhegemonic engineer was not the engineer he performed in all venues. Whenever their faculty advisor or other design-class faculty were present, Martin talked less and made sure that everyone on the team had something to say, input they negotiated during teamwork. Just as cultural frames of reference made it all but impossible to see Marianne's engineering capabilities and recognize her as an engineer, campus engineer identities saw Martin simply as a Nerd and could not recognize Martin's counterhegemonic leader, with its prototypically feminine social hostess aspects.

Thus, for both Martin and Marianne, and for other students as well, performances of engineer selves were not adequately anticipated by terms for campus engineer identities. In fact, inconsistencies between the campus engineer identity forms and the performances of engineer selves suggest that cultural knowledge about campus engineer identities was a lens through

which everyday performances were recognized and interpreted – in effect *given* meaning – and against which student engineers made decisions about performed engineer selves, that is about themselves *as engineers*. And, in time, campus engineer identity forms encoded a set of campus cultural practices through which power (held by those in ascendance in the campus engineer identities) was deployed to maintain the status quo.

IDENTITY IN PRACTICE AT PES

As promised earlier, these findings focused the research gaze on the figured world of identity production at PES, and then situated students' performances of engineer selves relative to the campus context. Here, students learned a complex vocabulary and organizational system to express engineer identities on campus. While they offered "typical engineer" among these, it hardly seemed to suggest the sort of "mature practitioner" Lave and Wenger's situated learning theory envisioned as a "leading" identity. In fact, the terms students used and their organization of them into three related categories provided ample evidence of the contestations about what "real" engineer meant on this campus. Rather than students moving along a trajectory toward some shared notion of "engineer," students went about their everyday lives deciding whether to affiliate with Greek life or not, devote themselves completely to their studies or take a more relaxed approach, align with an academic-science form of engineering or adopt the more expansive engineering form promoted in design classes. In other words, student engineers *differentiated* themselves from one another, but not in open-ended, anything-goes sorts of way, but in culturally salient dimensions. And, for most students, some facets of student behaviors came to be thought of as indicating an engineer type, while some actions and behaviors fell outside institutionalized recognition processes. In time, students assumed these terms (and other things) as cultural fact and deployed them to make sense of how their world was *supposed* or *imagined* to work, even when there was considerable empirical evidence that the world did not in fact work in the way presumed. Thus, campus life exemplified a culture; as Holland et al. (1998) described it, "[t]his collective ability to take imaginary worlds seriously . . . is the magic that anthropologists have tried to capture in the concept of culture" (p. 280). Ultimately, in spite of enormous student agency constructing subjectivities as engineers and performing themselves as engineers, and at times doing so in resistance to campus culture, little cultural change seemed likely to result from their creative performances. In other words, campus culture at PES was especially obdurate, not malleable, which may distinguish it from other scientific learning settings.

At PES *engineer identity* construction was a complex cultural production activity wherein individuals not only thought about themselves and performed themselves *as* engineers, but also had these performances framed, interpreted, and recognized through campus engineer-identity lenses. That is, forms for belonging (or in Holland et al.'s terms, frames of meaning) at PES provided a persistent backdrop against which individuals became engineers. As became clear in the two case studies of Marianne and Martin, the campus cultural and institutional practices exerted considerable influence over who was considered to be an engineer, in spite of how that person thought of her- or himself or how that person performed her- or himself as an engineer. In Marianne's case actually being an engineer took a backseat to being thought of *as* an engineer in this campus cultural context and she was filtered out, much as a polarizing lens filters out glare. Also, the sort of engineer Martin *was* could be seen only partially. "Cultural forms" do indeed affect and shape subjectivity (Holland et al., 1998). I cannot be sure from the study, but I suspect that far more of this recognition aspect of identity in context is at play than has been documented to date in (collegiate) science education.

Taking an anthropological, cultural production approach to unpacking campus engineer identities in the PES campus culture – the ways insiders talked about campus engineer identities, deployed them in their everyday cultural productions and contestations, and performed themselves as engineers – provided a way to understand how structural (ideological) penetrations (of the sort suggested by Willis) reach into the cultural level of everyday life on the campus via a complex set of endorsements and limitations put into play at the institutional level. In particular, the organization of campus engineer identities indicated the prestige of academic-science and the status of male-identified ways of life.

Campus engineer identities also indicated a set of campus-produced power relations that have implications for the sort of "real" engineer or "real" engineering campus culture promoted. Of course, all of these types, along with aspects not envisioned in them, are real engineers, as are both forms of engineering practice. But, taking a stand on campus that design engineering was "real" engineering meant challenging the ideology of academic science that held sway there, and being able to sustain a claim about one form of practice rising above others became a demonstration of power that played out during social interactions between students. For instance, a hardcore over-achiever could take credit for a nerd's work and a nerd would decide not to challenge that claim. This was facilitated because faculty thought of a hardcore over-achiever as a person whose test scores and grades ostensibly indicated being capable of doing engineering work at the highest levels (something that then did not need to be demonstrated at

every turn, an assumption not associated with women and those thought of as Nerds). Thus, Over-Achievers possessed a kind of credibility that Nerds and women did not enjoy. In addition, challenging higher status teammates could lead to backlash, especially having them use their power to further demean one's engineering credentials or commitment to the team, such as when Pete alluded to Samuel's always being late to team meetings – when in fact Samuel actually arrived after Pete, but before the scheduled meeting time. Eventually, Pete's aspersions undercut Samuel's reputation with their faculty advisor, in spite of Samuel performing far more engineering work on the team than Pete and Samuel's work ultimately benefiting Pete. In such a climate, campus engineer identities also functioned to self-limit actions of lower status students. Students developed a sense of the campus engineer identity of a peer and used that premise to decide how (or whether) to approach or challenge the colleague. For instance, Samuel consciously decided not to challenge Pete. Thus, campus engineer identities served as a way for student engineers to make sense of others and of themselves, and provided benchmarks for acting and interacting. These "benchmarks" encoded far more than Lave and Wenger's case studies anticipated, at least, especially structural and institutional influences on the everyday realm of student–student interactions, which Willis (1977) found central to understanding the interplay between constructing subjectivities and cultural confirmation of identity.

The status divide between Over-Achievers and Nerds grew out of PES institutional practices, which blunted substantive reform to engineering education expected from design courses. Institutionalizing engineering design courses within a conventional engineering curriculum offered an opportunity for a hybrid site that embodied aspects of both in- and out-of-school learning. On the one hand, having students working directly with engineers at government and industry worksites reinforced Nerd-affiliated students' thoughts about being an engineer and allowed promoting professional-engineer identities in ways not envisioned in the conventional curriculum. But on the other hand, embedding design courses in a conventional academic engineering program placed the professional-engineer (or industry-employed engineer) model at odds with Over-Achiever-affiliated students who were tightly linked to academic-science success. Though considered a major change to the campus curriculum, design courses failed to challenge the hegemony of academic science as institutionalized at PES and this also left unquestioned the stratification of Over-Achievers above Nerds.

Ultimately, campus histories – delivered and reinforced through institutional practices – set the stage upon which individuals worked out competing notions about being "real" engineers. When keeping the team's faculty advisor in the dark about Martin's central role in developing understandings

being presented by some teammates, he performed a limited version of himself and embodied his opposition to the prestige hierarchy. In these kinds of performances, students settled into a wide range of engineer behaviors – not letting faculty notice them, not challenging a high-status teammate – as they worked out their sense of themselves vis-à-vis engineering, just as simultaneously campus engineer identities settled onto individual students through their peers' using terms to refer to one another – for instance, making it possible to simplify Martin as a computer whiz and truncating the truly innovative engineer he performed, and impossible to notice Marianne among the Nerds.

Campus engineer identities at PES, then, served as reference points (pivots) for interpreting kinds of engineers – contextual, socially produced *imaginings* that marked how student-engineer identity performances were made sense of (or given meaning) by cultural recognition routines. Being an engineer at PES operated as if campus engineer identity terms recognized "essential" persona (albeit widely varying), in spite of the fact that student engineers were not reducible to the identities encoded in the terms. In fact, campus engineer identities only glossed students' performances, making terms simultaneously less than performances of engineer selves (unable to see Marianne as an engineer or Martin as a counter-hegemonic leader), and more (imbued with the weight of history where academic science was presumed to be a better set of practices than industry engineering practice, and where men's ways of life trumped women's).

The blindness of the culture to creative performances of engineer identities contributed to the obduracy of the campus culture. Students more likely to perform creative visions of engineer were also less likely to be thought of as engineers who should be part of determining what "real" engineering might be. In fact, six of the eleven seniors (students like Martin and Marianne) who expressed concerns about engineering culture as practiced at PES were moving and being moved toward the margins of engineering practice: preparing as a secondary math teacher, taking jobs in out-of-the-way sites of practice, and doing graduate work in interdisciplinary science-engineering fields such as environmental engineering. On the one hand, when such well-trained (especially Nerd) engineers leave the professional mainstream, opportunities diminish for cultural change led by these individuals. And on the other hand, student engineers who found a comfortable culture, especially engineers from high-powered academic-science-affiliated locations, not only lacked the proclivity and expertise to be responsive to changing realities in the world, but also worked diligently to keep things that way. Thus, the campus culture being produced through such shifts in the mix of campus engineer identities conserved the past, instead of reforming it.

Finally, studying identity as conceptualized here has value because it made the layers, dynamics, and tensions – as well as the deep campus cultural component – of identity production visible. Identity is not merely something that people express about themselves, or shape in the presence of other forces; it is also and simultaneously something that learning communities make of people. In spite of Marianne's *identifying* with being an engineer and *performing* herself as an engineer, she was not *identified* as an engineer, making her suspect *as an engineer.* On the other hand, Martin's *identifying* with being an engineer, but performing a creative engineer self had many facets that were not *identified* as being an engineer. When considered in this light, engineer identity was not merely something that flowed with and through an individual, but rather something that was held between person and campus culture. That is to say, no matter how deeply Marianne believed she was an engineer (her construction of subjectivity) and in spite of enormous empirical evidence of her engineering skill (a performed engineer self), sans ways for campus culture to recognize (or in Willis' terms "confirm") her *as an engineer*, she was not *thought of* as an engineer (having an engineer identity there). In PES campus culture where engineer identity was a product of this enculturated process, the facet of culturally produced engineer identity that mattered was being *thought of* as an engineer and this did not happen for Marianne. Recall an earlier quote from a student engineer talking about whether a woman could be considered a Nerd – the sort of engineering self that Marianne performed:

> You don't think of women as that [fitting among Nerds], I guess. 'Cause, at least at this school, I think guys here so much appreciate that a girl chose to come to this campus that you're just like, "Great!" There are so many guys that you can say "this guy's a nerd," the pocket-protector-wearing guy. [But he couldn't say that of a "girl."]

This comment came from Martin who knew Marianne better than almost any other student engineer. (And, Martin was among the most open-minded student engineers when it came to his overt thoughts about women's place on campus.) Though he knew full well, and deeply appreciated, her skill as an engineer, his referencing cultural forms (cultural knowledge about campus engineer identities) and being unable to place her *as* an engineer demonstrate three things, at least. First, that he was a member of the campus culture who could deploy its taken-for-granted knowledge. Second, that implicitly held cultural forms had great force to frame his view of the world and women's place there. Third, that Martin's falling back on such cultural forms also reinforced Nerds as a men-only way of life, effectively reproducing the gender status quo at PES, just as his hiding his GPA reified the Over-Achiever/Nerd divide. Thus, his actions as a member of the

culture, even a person who routinely expressed disdain for the ideologies of privilege grounded in academic-science prestige and gender status, reinforced the culture and did not change it. And, when his creative engineer self was reduced to its categorical simplicity, others on campus did not come to think of a computer whiz in more creative terms, but continued with the concatenated version anticipated by cultural forms.

Let us then return to the issue of the extent to which the engineering campus research parallels K–12 sites of learning. When I read sociocultural/cultural-historical accounts of identity production in context, such as those of a teacher developing a sense of himself as a "good" teacher in a high school (Roth et al., 2004), young women's emerging sense of themselves as scientists (Brickhouse et al., 2000; Brickhouse and Potter, 2001), and urban youth gardeners' sense of themselves becoming scientists (Rahm, 1998); I do not see that these communities have the kinds of expansive, reified cultural forms for belonging that existed at PES. In fact, in science education, based on Rahm's research (Rahm, 1998; Rahm and Charbonneau, 1997), it appears that students in K–12 students take for granted a much more diffuse image of "scientist," a stereotype, against which to consider their own needs, interests, and desires. Such a "scientist" seems different from campus engineer identity terms. Thus, I wonder if there is something about the PES campus culture that provided different forces to shape subjectivities. Roth et al.'s teacher, changing his teaching practice to better match the realities at his Philadelphia high school, seemed able to change himself into a teacher that "fit" in that context. Eisenhart's environmental biologists could "acclimate" to their new life in a conservation corporation, in spite of its offering a different kind of "biologist" than the one offered on their campus. Marianne simply did not have these options. For her, belonging was foreclosed because there was no way for her to change herself to fit into the images of engineer at PES. This reinforces that learning settings vary widely and we continue to have much to learn from them. Unlike most K–12 settings, PES represented a learning setting that was its own culture, a place where even though individuals carried with them out-of-campus cultural knowledge that reached back to their home communities and other affiliations, the business of becoming an engineer swamped earlier home-culture knowledge and gave prominence to campus ways of life and sets of meaning; that is, the campus encapsulated its own culture. This is not to say that other cultural frames like mainstream U.S. life did not impinge on students' at PES as documented elsewhere (Brickhouse and Potter, 2001; Seymour and Hewitt, 1997), but that in the research that I performed these did not come to the fore. (In fact, I feel certain that an ethnographic approach that paid attention to members of under-represented racial and ethnic communities would reveal the

whiteness of PES. But this was not possible because the numbers of students from under-represented communities were too low and they received too much scrutiny from faculty, making research far too risky.)

Thus, the findings from PES corroborate Holland et al.'s (1998) notion of "identity in practice," and could be described in terms of several contexts of activity. First, and the one that I have paid the most attention to in this article, is the *figured world*. These frames of meaning "carry dispositions, social identification, and even personification just as surely as they carry meaning" (p. 271). The second context of activity was *positionality*, the accounting for stratification and hierarchy via power, status, and rank that runs with and through figured worlds. As the findings made evident, position mattered in social interactions, was made evident in the organizing principles for the three identity categories (Nerd, Academic-Achiever, and Greek), and owed much to the institutionalization of life on campus. Third, was the *space of authoring*, a Bakhtinian notion of how one answers (or responds to) the world one faces, an answer that is not predetermined nor wholly open to choice (Bakhtin, 1981). As such, authoring suggests not autonomous action, but social efficacy, the many ways that one integrates intimate and public spaces (p. 272). At PES this was a very limited space, indeed. Those having concerns about the ways in which the campus worked on people, especially its proclivity to elevate those who exploited the work of others and cut corners to gain advantages over their colleagues, knew that speaking out meant being (mis)cast as "not engineer material." Thus, answering with a critical voice meant being viewed as a person who had no right to speak. And finally, the fourth concerns the *making of worlds*, which allows agents through their actions to shape the world in which they live. Though many researchers work from the assumption that such "makings" will in fact be changes, at PES this was not the case. The world was being re-made – with a vengeance – in its own image, not changed.

PES, then, is a particularly illustrative case of the sort of complexity in professional identities offered on a college campus. On this campus where power and prestige production went hand in glove with becoming an engineer and where students were separated in a real sense from their past home lives and other affiliations, students' personal futures were at stake and campus-preferred ways of life held tremendous sway not only over them as students, but over their careers as engineers as well. As contextualized in activity, identity production at PES was a process through which persons' sense of themselves as engineers led to performances of engineer selves that were viewed through lenses of cultural forms for campus engineer identity, and where recognition *as* an engineer conferred belonging. Here, recognition carried the day. This process provided a way to account for the pull of the status and power garnered by earning scientific and engineering

credentials (identifying with engineering), without losing track of the push that ideologies of privilege deliver to many students (being identified and elevated, or misrecognized and cast out, as an engineer). This points up the importance of taking cultural forms for identity seriously, not only because they have enormous influence, but because they encode a remarkable understanding of what students face when trying to develop into scientific and engineering selves. Though students were agents in remarkable ways, agency – even when it offered resistance to the campus status quo – failed to change the culture. I contend that this obduracy owed much to the stability of the campus engineer identity terms.

NOTES

1. Rahm and Charbonneau (1997) and Eisenhart (1996) are notable exceptions to the lack of attention paid to scientist identity in educational settings. As part of Rahm's study of an urban gardening site for middle-level students, students drew a picture of what they thought of as a scientist. These renderings gave very stereotypic images – men in white lab coats, wearing glasses, with beakers and other "science" artifacts present. Eisenhart's campus environmental biologist contrasted with the sense of environmental biologist at a conservation corporation.
2. The production of gender via social interactions mediated by campus culture served as the focal point of an earlier article (Tonso, 1999). A wide range of data captured gender production particulars, but one set of interview questions provided especially poignant findings. When asked what it was like to be a man on the campus, then subsequently asked what it would be like to be women, men students gave lengthy depictions of campus life as a place that privileged men and expected women to have extra burdens and put up with troublesome behaviors – facts of life documented in field notes. Yet, in a subsequent question, when asked what equality meant to them and whether equality existed on campus, men students assured me that "everyone was treated equally." Thus, through a complicated cultural process of taking for granted the way their campus world was *supposed* to be – that is by demonstrating campus cultural knowledge about gender – instead of noticing the way their campus actually worked, student engineers actively *learned* to *not* notice a campus gender-status ideology with its roots in wider U.S. society.
3. This rendering of women's place on an engineering campus appears on other campuses as well. For instance, an MIT alum related that this information was conveyed via the adage that "brains times beauty equals a constant."
4. Professor Mason provided an example of the least progressive faculty on campus (Tonso, 1996). He was an alumnus of the campus, routinely challenged campus changes since his graduation decades earlier, and on a regular basis questioned whether I had ever been a "real" engineer. As a professor, he used a set of militaristic metaphors with violent imagery that many students found off-putting (and I found representative of a military masculinity), such as thinking of appropriate teamwork as "divide-and-conquer," and commenting that student brain-storming needed to "poke around in there with a bayonet." His proclivity to use not-so-subtle gender double-entendres and to encourage their use by students made women – co-teachers and students – uncomfortable. His notion of

a team leader was a person who "cracked the whip," "tasked others to do work," and otherwise controlled other people.

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