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The stereotypical MIT student is defined at least in part by a love of computers, and indeed, the most popular undergraduate major at MIT is Electrical Engineering and Computer Science, referred to by students as Course VI, after its department number. To most outside the MIT community, and to many within it who are not Course VI, those who study computers are a homogenous bunch: white, male, bespectacled, unkempt, socially impaired but academically gifted. But actual Course VI students can be divided into three groups based on which degree track within the department they follow: Electrical Science and Engineering (Course VI-1), Electrical Engineering and Computer Science (Course VI-2), or Computer Science and Engineering (Course VI-3). Members of the Course VI community perceive sharp differences between each of these three groups, especially between Course VI-1, which focuses on electrical engineering and hardware design, and Course VI-3, which focuses on computer science and software design. Course VI-2 is a combination of the two that gives students a general competence in both areas but specific expertise in neither, and, as it enrolls 48.2% of Course VI majors, is the most popular of the three tracks. Of the remaining Course VI students, almost twice as many students major in VI-3 (33.6% of students) than VI-1 (18.2%) (MIT Office of the Registrar, 2006b).

What are the differences between students in VI-1 and VI-3, and why does a given Course VI student choose one degree program over the other? Based on casual interviews with approximately half a dozen Course VI students, I will attempt to answer these questions from the point of view of an essentialist, a structuralist, and a postmodern constructivist.

### *An Essentialist Viewpoint*

When students explain their reasons for being VI-1 or VI-3, they tend to say that whichever branch of Course VI they are in is easier for them, that they have “no intuition” for the other side of Course VI, and that their field is simply more appealing to them on a basic level than its opposite. As one VI-3 student explained, “I’ve never seen a beautiful circuit, but when I see good code it can be beautiful, it’s like seeing perfection...it’s almost a religious experience. I imagine the opposite is true for VI-1ers.” When further pressed as to *why* they felt their branch of Course VI was easier or more

“beautiful” than the other, students were either unable to come up with an explanation, or gave some variation of “it’s just the way you think.”

These student-provided explanations are in line with the essentialist sixteenth-century French notion of *naturel*, or “nature,” which parents used to help decide their son’s careers. As Davis (1986), a historian of this time period, explains:

[Naturel] could include temperament, character, and talent - and with regard to the boy’s vocation, something God had called him to, but whose signs were in him, in his gifts and inclinations. (p. 59)

While the premise that a person’s “gifts and inclinations” are inborn is a plausible explanation for why a student would find either circuit boards or programming languages more intuitively easy and intellectually appealing, the idea that these traits come from God is somewhat outdated and impossible to scientifically validate. Instead, it seems likely that these natural talents and preferences are a result of complex genetic, neurochemical and developmental factors. A comprehensive study of what motivates students to be VI-1 or VI-3 would necessarily involve the use of modern scientific techniques such as gene mapping and brain imaging. In the current absence of such studies, some of the existing literature on gender differences in reasoning abilities will be used to illustrate a potential biological difference that causes students to be either VI-1 or VI-3.

When asked the difference between VI-1 and VI-3, one VI-3 student said that “VI-3 is definitely the weaker sex of Course VI,” and those around him concurred. Additionally, when Course VI students were asked which major had more women in it, there was unanimous agreement that it was VI-3, a judgement that was confirmed by actual enrollment data (MIT Office of the Registrar, 2006a). Given that VI-1 is characterized by complex mathematical calculations and hands-on manipulation of circuits, or, as one student put it, “real engineering,” and VI-3 is characterized by abstract problem solving and mental manipulation of ideas, and is described by students as an “art form” and a “creative process,” it is clear that there is a basis for students’ assessments of VI-1 as more oriented towards masculine thought and VI-3 as more oriented towards feminine thought. Therefore, studies on differences between male and female thought can also be used to analyze differences between VI-1 and VI-3 thought, and explain what motivates a given student to be more interested in one or the other.

Many recent studies show that differences in male and female thought may have a hormonal basis. For instance, males with low levels of testosterone due to idiopathic hypogonadotropic

hypogonadism (IHH) or androgen insensitivity syndrome (AIS) are worse at spatial reasoning than males with typical levels of testosterone, and females with high levels of androgens due to congenital adrenal hyperplasia (CAH) have enhanced spatial reasoning skills (Runyan, 2005). Furthermore, less than 24 hours after birth, male babies look longer at a mechanical mobile than a human face, and female babies display the opposite pattern (Connellan et al., 2000), which may have to do with the varying levels of male and female sex hormones they are exposed to in the womb. Data such as these, and the fact that there are more female students in VI-3 than in VI-1, indicate that sex hormone levels may strongly influence aptitude for either computer science or electrical engineering. Students who were exposed to higher levels of testosterone in the womb likely developed advanced spatial reasoning skills as a result, making them more suited for electrical engineering, whereas students who were not exposed to as high levels of testosterone did not develop this aptitude, making them more suited for computer science. Through studies such as these, the historical concept of a God-given *naturel* can be explained through the latest developments in science, which can in turn explain students' inherent predispositions towards VI-1 or VI-3.

#### *A Structuralist Viewpoint*

The essentialist explanation for a student's inclination to be VI-1 or VI-3, like essentialist explanations of any social phenomena, is necessarily incomplete because it "provides no basis for determining the nonbiological conditions" that influence human behavior (Merton, 1996). If preference for electrical engineering over computer science is a result of high levels of prenatal testosterone, then why are there women in electrical engineering? And why are men, who presumably uniformly have high testosterone levels, more likely to study computer science than electrical engineering? In fact, the essentialist assertion that there are more women in VI-3 than in VI-1 is misleading, since VI-1 actually has the highest proportion of female students of all three divisions of Course VI (36.9% as opposed to 24.9% for VI-3 and 28.6% for VI-2), indicating that the larger number of women in VI-3 than VI-1 is more indicative of the overall larger number of students in VI-3 than a trend for women to prefer VI-3 over VI-1. Since biological explanations for major preference are inadequate, the influences of social structures must be considered.

One explanation given by almost every student for the larger number of students in VI-3 than in VI-1 was the fact that more children are exposed to computers while growing up than are exposed

to circuit boards, and it is relatively easy to become proficient in programming by tinkering with the family PC or a graphing calculator, while it is almost impossible to become proficient in circuit design without formal instruction. As a result, many students arrive at MIT with a basic competence in computer science, and continue to study it because “they think it’s what they’re good at it, even if they haven’t tried a lot of EE.” Although students did tend to describe their preference for VI-1 or VI-3 as something they “just had,” they often went on to acknowledge that they preferred whichever of the two fields they were better at, and in turn they were better at whichever one they studied because they had more practice in it. One VI-3 student illustrated this point by saying, “When I start a coding problem I immediately see a lot of aspects of it and start thinking of how to solve them, when [my VI-1 friend] does, she doesn’t think of half of those things...probably because she codes less.”

Furthermore, several students offered familial influence as an explanation for major preference, and pointed out that “there are a lot of people here who study what their parents do.” One VI-1 student described being given a PCB (printed circuit board) with several flashing lights as a child by his father, an electrical engineer, and becoming very enamored of it and how it worked. Most parents who are not electrical engineers would not give such a gift to their child, and so those whose parents do not have an EE background are less likely to have such an early exposure, and hence a chance to experiment with circuit boards and develop a sense of competence with them. As Derné (1992) illustrates for the case of North Indian men, family influence and pressure can have a dramatic impact on lifestyle and choice of career. Data on the occupation of the parents of VI-1 versus VI-3 students would be helpful for supporting this theory, as would a more comprehensive set of interviews with students as to why they chose their division of Course VI.

An additional structural element to consider is Merton’s concept of the interaction between “socially defined goals, purposes, and interests” and the “phase of the social structure [that] defines, regulates, and controls the acceptable modes of achieving these goals” (1996, p. 117). A goal that is held by the majority of American society, MIT students included, is that of having enough money for a “nice life style,” and the most socially accepted means of achieving that goal is through having a job. Multiple students pointed out that the larger number of students in VI-3 than in VI-1 is probably at least in part because “the job market for computer scientists is huge, especially with a degree from MIT,” so it is a major that appeals to people who want a high paying job, whereas “only

people who really love electrical engineering and want to do it for the rest of their lives are VI-1.” Evidence for this point comes from the trend for more VI-3 students to graduate and get a lucrative job in finance instead of industry or academia than for VI-1 students to do the same thing. Again, a more comprehensive set of interviews would provide more evidence for economic influences on major choice, as would data on the average starting salaries of computer scientists versus electrical engineers.

Just from this brief overview, it is clear that childhood experiences, family influences, and the job market all play important roles in a student’s decision to be VI-1 or VI-3, and without considering these elements of social structure, any analysis of the difference in students between the two majors will necessarily be incomplete.

#### *A Postmodern Constructivist Viewpoint*

While the influence of social structures on student major selection cannot be entirely dismissed, simply analyzing data on differing parental occupations and starting salaries between VI-1 students and VI-3 students cannot provide any real insight into what it means to have either identity at MIT. A full examination of the processes that construct VI-1 and VI-3 identities would take years of fieldwork, dozens of in depth interviews, and hundreds of pages of analysis; given that none of those requirements are an option here, I will attempt to illustrate what such a study might look like through a brief analysis of the discourse of “hard core”ness surrounding the two majors.

The VI-1 and VI-3 curricula actually share a significant number of classes, and at least one student acknowledged that “realistically there’s not a huge difference between them if you only take the required classes, only if you take extra grad [graduate level] classes.” Yet despite their large areas of overlap, across all three divisions of Course VI, most students describe VI-1 as more “hard core” than VI-3. They support this assertion by citing the fact that electrical engineering requires “working with your hands” in a way that computer science does not, and many further asserted that “anyone can write code that works,” even if it is not of particularly high quality, but “not everyone can design a functional circuit.” As previously mentioned, one student asserted (and many agreed) that as opposed to VI-3, VI-1 is “real engineering,” a description that is particularly meaningful in light of MIT’s engineering-centric culture. Where does this discourse of electrical engineering as more “real,” and therefore more “hard core,” than computer science come from, and what are its implications for

students in either major?

As Foucault points out, discourse and the creation of meaning operates in a historical context (Hall, 1997). The idea that “real” engineering involves “working with your hands” has origins in the specific history of engineering in the West; despite students’ claims, “working with your hands” is not an ahistorical, innate and defining feature of “real” engineering. Similarly, the idea that soldering a circuit qualifies as “working with your hands” but typing at a keyboard does not is also historically rooted, and is perhaps strongly related the current widespread availability of computers. If a small child can play games by using a keyboard, then work that requires use of a keyboard can not be as difficult, or as “real,” as work that involves working with the electrical components that make keyboards function, or so the logic goes among Course VI students. Furthermore, the notion that being “hard core” is a desirable trait is embedded in the broader context of MIT’s “work hard, play hard” culture, exemplified by the oft-repeated saying that “getting an education at MIT is like getting a drink from a fire hose.” Undoubtedly being a “hard core” engineer would not be such a coveted identity at a small, liberal arts university with a more humanistically inclined student culture.

The discourse of VI-1 as more “hard core” than VI-3 has real implications for how students in either major construct their identities. Students who are VI-1 and enjoy their major’s prestige often make their identity as an electrical engineer known by carrying around their “nerd kits,” distinctive looking boxes of circuit components required for many of the VI-1 labs, thus signifying their enrollment in a VI-1 lab and status as a VI-1 student. VI-3 students, however, often have difficulty reconciling their love of computer science with their desire to not be seen as less “hard core” than their VI-1 peers. Some students attempt to resolve this conflict by being VI-2 and taking mainly computer science electives, thereby minimizing the obtrusiveness of their “soft” VI-3 tendencies, in a manner similar to Goffman’s notion of covering (1963). Others challenge the quasi-hegemonic dominance of VI-1, such as the VI-3 student who takes umbrage to those who characterize VI-1 as more difficult than VI-3, pointing out that “it’s really hard to write *good* code,” and most VI-1 students “are terrified of 6.046 [Introduction to Algorithms, a notoriously difficult VI-3 class].” Still others reconcile their interest in computer science and their desire to be “hard core” by redefining what it means to be “hard core” in the first place; more than one student told me that neither department was inherently more “hard core,” since to be “hard core” means to throw oneself completely into one’s work and excel at it, regardless of what the work in question is.

As this brief introduction clearly shows, there is much more to being VI-1 or VI-3 than having had an early childhood exposure to a circuit board or a computer. Any attempt to describe the differences between the two majors without seriously examining the discourses surrounding them and the processes by which students construct their identities as electrical engineers or computer scientists will only scratch the surface of a multi-layered and very complex society.

### *Conclusion*

As these three different perspectives on the same topic have hopefully made clear, what you see when you examine a social phenomenon depends on what you are looking for. If you are an essentialist looking to divide the world into discrete and easily identifiable components, you will end up with an oversimplified and pseudo-scientific explanation for a question that has been so altered by your attempt to force amorphous social categories into rigidly defined biological ones that it no longer resembles, or is relevant to, reality. If you are a structuralist attempting to explain human behavior in terms of social structures your explanation will be slightly less shallow, but you will be left with the question of where those social structures came from in the first place, and you will completely miss how the people you are studying experience their social reality. Finally, if you are a postmodern constructivist who sees all meaning as created through discourse and historically situated, you will be able to provide a nuanced analysis of complex social behaviors, but at the risk of missing out on any possible underlying realities that are not socially created. Each approach has its place - an essentialist explanation for one's sense of self will be just as meaningless as a postmodern constructivist account of astrophysics - and perhaps the world can be best understood from a combination of all three perspectives.

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