

MEET YOUR STUDENTS. 1. STAN AND NATHAN*

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Stan and Nathan are juniors in chemical engineering and roommates at a large midwestern university. They are similar in many ways. Both enjoy partying, midnight pizza runs, listening to rock and watching TV. Both did well in science and math in high school, although Nathan's grades were consistently higher. Both found their mass and energy balance course tough (although they agree the text was superb), thermodynamics incomprehensible, English boring, and other humanities courses useless. Both have girl friends who occasionally accuse them of being "too logical."

For all their similarities, however, they are fundamentally different. If single words were chosen to describe each of them, Stan's would be "practical" and Nathan's would be "scholarly" (or "spacy," depending on whom you ask). Stan is a mechanical wizard and is constantly sought after by friends with ailing cars and computers, while changing a light bulb is at the outer limits of Nathan's mechanical ability. Stan notices his surroundings, tends to know where he put things, and remembers people he only met once; Nathan notices very little around him, misplaces things constantly, and may not recognize someone he has known for years. Nathan subscribes to *Scientific American* and reads science fiction and mystery novels voraciously; Stan only reads when he has to. Stan has trouble following lectures; Nathan follows them easily, but when instructors spend a lot of class time going through detailed derivations or homework assignments he already understands he gets bored and his attention wanders.

When Stan takes a test he reads the first problem, reads it again, and if the test is open-book tries to find an identical worked-out problem and copy the solution. If he can't find one, he searches for suitable formulas to plug into. He frequently rereads the problem while working on it and repeats each numerical calculation just to be on the safe side. When he has gone as far as he can go he repeats the process on the second problem. He usually runs out of time and gets class average or lower on the test. Nathan reads test problems only up to the point where he thinks he knows how to proceed and then plunges in. He works quickly and usually finishes early and gets high grades. However, he sometimes blows tests because he makes careless errors and lacks the patience to check his calculations, or he fails to read a question thoroughly enough and misses important data or answers a different question than was asked.

The one place where Stan outshines Nathan academically is the laboratory. Stan is sure-handed and meticulous and seems to have an instinct for setting up and running experiments, while Nathan rarely gets anything to work right. Nathan almost had a nervous breakdown in analytical chemistry: he would repeat a quantitative analysis five times, get five completely different results, and finally average the two closest estimates and hope for the best. Stan, on the other hand, would do the analysis twice, get almost perfect agreement between the results, and head for a victory soda while Nathan was still weighing out the reagents for his second attempt.

Stan did well in only one non-laboratory engineering course. The instructor used a lot of visual demonstrations—transparencies, pictures and diagrams, and actual equipment; provided clear outlines of problem solution procedures; and gave practical applications of all theories and formulas the students were required to learn. Stan claimed that it was the first course he had taken that seemed to have

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anything to do with the real world. Nathan thought the course was okay but he could have done with a bit less plug-and-chug on the homework.

*Stan is a sensor; Nathan is an intuitor.*¹ Sensors favor information that comes in through their senses and intuitors favor internally-generated information (memory, conjecture, interpretation). Sensors are attentive to details and don't like abstract concepts; intuitors can handle abstraction and are bored by details. A student who complains about things having nothing to do with the real world is almost certainly a sensor. Sensors like well-defined problems that can be solved by standard methods; intuitors prefer problems that call for innovation. Individuals of both types may be excellent engineers: the observant and methodical sensors tend to be good experimentalists and plant engineers, and the insightful and innovative intuitors tend to be good theoreticians, designers, and inventors.

The degree to which someone favors sensing or intuition can be determined with the *Myers-Briggs Type Indicator*, a personality inventory that has been administered to hundreds of thousands of people including many engineering students and faculty members. Most undergraduate engineering students have been found to be sensors and most engineering professors are intuitors. A mismatch thus exists between the teaching styles of most professors, who emphasize basic principles, mathematical models and thought problems, and the learning styles of most undergraduates, who favor observable phenomena, hard facts, and problems with well-defined solution methods. Intuitive students would consequently be expected to enjoy a clear advantage in school, and indeed intuitors have been found to get consistently higher grades except in courses that emphasize facts, experimentation, and repetitive calculations.

For many sensing students, the disparity between the way they learn best and the way they are generally taught is too great: they get poor grades no matter how hard they work, become disillusioned, and drop out. Felder and Silverman¹ give several ways instructors can accommodate the learning styles of these students without compromising their own teaching styles or their ability to get through the syllabus. The accommodation is well worth attempting: sensors are sorely needed in industry and may do exceptionally well there if they manage to survive school.

Postscript: 15 years later.

Nathan graduated *magna cum laude*, went to graduate school and got a Ph.D., worked for several years in the research and development division of a major chemical company, got several important patents, moved to manufacturing, and ended up as a group leader supervising a team of designers and systems analysts. Stan struggled through the curriculum, graduated in the bottom third of his class, and got a production engineering job in the same company Nathan went to work for. His mechanical talents soon became apparent and he was put in charge of a trouble—shooting team that came to be in great demand throughout the plant. His managerial skills then led to a rapid series of promotions culminating in his becoming the youngest corporate vice president in company history. Among the thousands of employees in the branch he heads is Nathan, with whom he gets together occasionally to talk over old times. Stan thoroughly enjoys these meetings; Nathan also enjoys them but perhaps not as much.¹

¹ See R.M. Felder and L.K. Silverman, "Learning and Teaching Styles in Engineering Education," *Engineering Education* 78(7),674(1988), and G. Lawrence, *People Types and Tiger Stripes*, Center for Applications of Psychological Type, 2nd Edition, Gainesville, 1982. Stan is a representative sensor and Nathan a representative intuitor, but not all sensors are just like Stan and not all intuitors are just like Nathan. Sensation and intuition are preferences, not clear-cut categories, and all human beings exhibit characteristics of both types to different degrees.