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USU College of Engineering, "Engineering Thinking | College of Engineering" (2015). *College of Engineering News*. 20.
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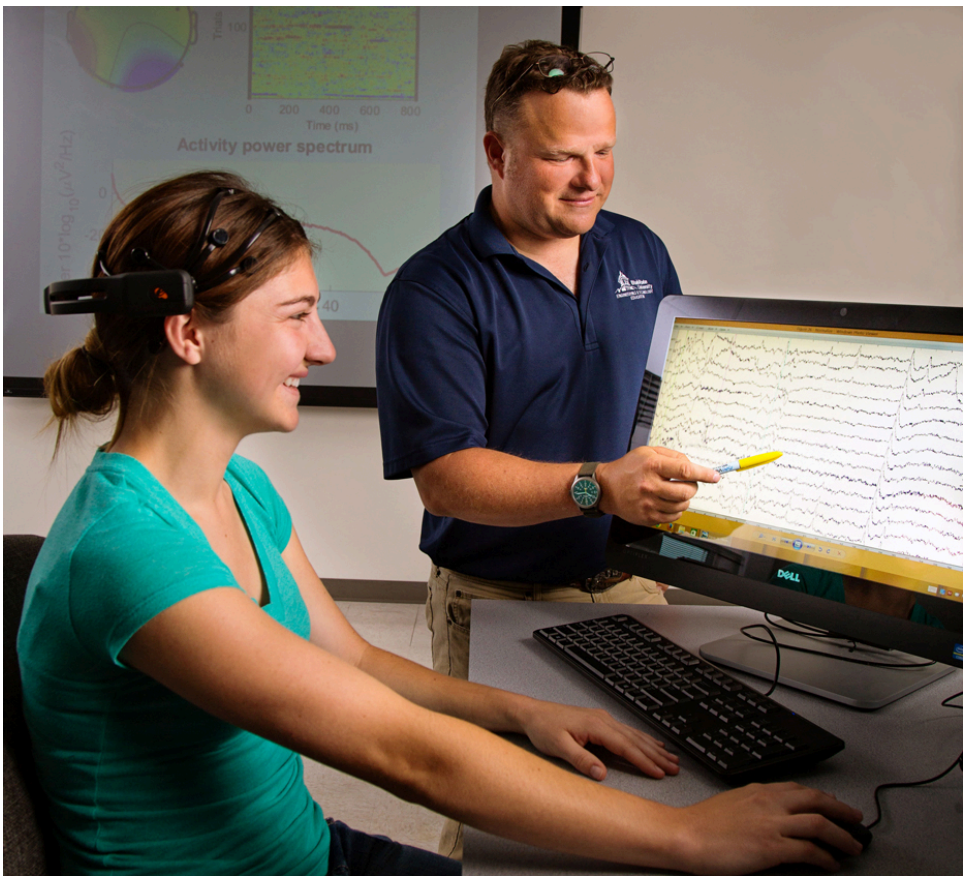
Cracking the Egg on Spatial Cognition

Nov. 2, 2015 - It's no surprise: engineering courses are tough. Professors assign complex homework problems that can take hours to solve, and for some the experience feels like drinking from a fire hose.

Most engineering programs begin with a handful of rigorous courses in statics and dynamics that can be stumbling blocks for some. This has engineering education experts looking for retention solutions and rethinking how these difficult courses are taught.



Dr. Wade Goodridge, assistant professor of engineering education, says part of the solution will come from a more thorough understanding of spatial thinking – specifically spatial ability.

"Spatial ability means being able to visualize an object in different orientations," said Goodridge. "For example, choose an item on your desk and mentally pick it up and rotate it. Or take the object and mentally slice it in half. Are you able to visualize the pieces in this new perspective?"

Spatial ability, sometimes referred to as spatial cognition, is a crucial skill for many hands-on professionals including dentists, airline pilots and engineers. Experts have shown that spatial thinking is highly correlated to success in engineering majors and success in an engineering career. Experts also say spatial ability can be taught and improved.

What's unclear, says Goodridge, is how much spatial ability a student has when he or she shows up for their first lecture and how much impact that has on their ability to succeed in a course.

"We know that people have different levels of spatial ability," he said. "In statics we look at a lot of force interaction type problems. Most students can easily visualize a two-dimensional problem, but when we move to 3-D problems it gets more complex."

Goodridge suspects that some students struggle with more challenging concepts because it can be difficult to mentally construct the many components in a force interaction exercise. To learn more, he's conducting new research aimed at analyzing brain activity as it relates to how students solve these types of complex mechanics problems.

"We use an electroencephalogram, or EEG, headset to look at the neural activity in research subjects," he said. "What we discovered is that the mental cutting test takes more neural involvement than other commonly used spatial visualization tests."

In fact, the classic mental cutting test, developed in the 1930s, is so difficult, Goodridge rarely sees a perfect score among his students. The interesting connection is that the homework problems he assigns in his statics course require a similar level of neural engagement.

"So if statics is a stumbling block, are there ways to teach it that are more spatially involved?" Says Goodridge. "Can we design an intervention within the curriculum for those students who aren't as spatially adept to better understand the material?"

Through his ongoing research, Goodridge is trying to do exactly that. He'll present on his findings and on the importance of spatial thinking to a group of researchers at Northwestern University this fall.