The scientist and the contortionist

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Watching a ballet dancer or circus acrobat perform, who hasn't winced at the thought of trying to replicate the impossible flexibility on display? Emilie Mackie '07, a neuroscience major, wondered what exactly is happening to the brain during this type of visceral response to someone else's physical state, so she cast about for a contortionist.

Mackie, with fellow researcher Emily Cross, a fourth year graduate student in cognitive neuroscience, developed a research study designed to use transcranial magnetic stimulation (TMS), a type of neuroimaging, to determine how the brain responds to "impossible" visual scenarios using both inanimate objects—things like coffee mugs and umbrellas—and human beings. The objects were photographed using hidden supports to make them appear to defy gravity. In looking for a human being who could do the "impossible," Mackie and Cross were lucky enough to find Christina Luccio '07, a contortionist.

Luccio, an alumna of Circus Smirkus camp who has trained with former Cirque du Soleil artists, can contort herself into shapes that almost hurt just to watch, although, she says, the poses are not painful to her. Together, Luccio, Mackie and Cross came up with a series of poses, some that anyone could assume and others that would appear, Mackie hoped, "impossible" to the mind's eye.

Mackie recruited 20 healthy volunteers for the study and gave them all fMRI brain scans. Using the fMRI scans as a kind of road map, she applied TMS to localized areas of the brain while the volunteers looked at photos of Luccio in both normal and contorted poses and photos of

objects in normal and "impossible" arrangements. The magnetic pulse of the TMS paddle modifies the activity in a small part of the brain, allowing Mackie to map the function of different parts of the brain as the subjects mentally respond to the photos. The experiment was designed, Mackie explains, to create a two-by-two matrix for comparison: human vs. object and possible vs. impossible.

Mackie and Cross hope to learn what is happening to the brain when it sees the impossible (or at least, the highly improbable), and their work is based, in part, on earlier studies showing a "mirroring effect" in the brain; that is, when people look at images of human behavior, their brain activity is similar to the activity that would appear if they themselves were actually doing the activity. The brain, this research suggests, responds the same whether a person is doing something or only imagining doing it.

For Mackie, who will graduate in June, the ability to conduct this research as an undergraduate was an unparalleled opportunity, one for which she credits Dartmouth's intimate scale and its ability to attract top researchers and research facilities. "Nowhere but Dartmouth," says Mackie, would the resources and independence for this level of research be available to an undergraduate. She is especially grateful, she adds, to have had the mentoring and guidance of Cross and Antonia Hamilton, a research associate in the department of psychological and brain sciences. As an undergraduate, Mackie has been able to attend the mammoth Society for Neuroscience annual conference, and she credits her small classes in which professors discussed their own research with inspiring her to pursue graduate level research. If the results from the TMS study prove interesting enough, there is even the possibility that Mackie will be a published researcher, all before setting foot in graduate school.

Source: Dartmouth College