3T MR Research Program

Center for MR Research

University of Illinois at Chicago

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3T MRI Safety Update

By Mike Flannery

The most commonly reported safety hazards within an MRI environment are thermal burns. MR imaging related burns may be caused by RF energy tissue deposition or more commonly due to induced eddy currents in electrical conducting materials forming a closed loop. Some examples of conductive materials are wires, leads, and even crossed patient limbs. The 3T MR Research Program would like to inform the research user groups about an easily overlooked safety hazard. Multipurpose fabrics that contain silver microfibers (SMF) or copper threads that are marketed for antibacterial and odor-fighting properties could pose a thermal burn risk. These types of fabrics are typically found in certain athletic clothing, socks, and apparel worn under certain orthotic devices such as limb or spine braces.

The most likely scenario where this could occur is with a sedated patient who is unable to express any signs of heating during the MR examination. The picture below is one such case where a sedated patient was wearing a SMF embedded undershirt during a MR exam for evaluation of scoliosis. The patient suffered 2nd degree burns due to electromagnetic eddy currents generated along the fabric seam where the SMF was most concentrated and in direct contact with skin.

A linear erythematous blistering eruption is noted on the patient's right flank minutes after completion of MR imaging brain and spine.

The 3T MR Research Center would like to ask that all user groups ask their subjects to refrain from wearing such clothing on the day of their examinations. The MR technologist will also confirm this type of clothing is not being worn by the subject prior to entering the room.

Technology Trends

Since Chicago is famous for its frigid winter weather, I thought it would be prudent to mention new advances in MRI cryogen technology. Superconducting MR magnets rely on liquid helium to maintain a constant temperature of -269° Celsius (-452° Fahrenheit) for normal operation. There is a finite supply of helium found naturally on Earth and the ever-growing demand can lead to possible future shortages such as the one experienced in 2015. Ultimately, other methods to reduce this demand must be explored. GE Healthcare has been actively working on a solution to reduce the consumption of helium with the new technology known as "Freelium". This technology is designed to use about 1% (20 liters) of liquid helium compared to current conventional MRI magnets which use around 2,000 liters. This design is completely self-contained and sealed and would not require a helium refill upon installation.

The Freelium magnet technology offers additional advantages such as reduced installation and siting costs. Freelium will not require the extensive venting and exhaust systems utilized in current MR systems. This will allow a wider logistical range where the magnet can be installed within each facility.

Sylvia Morelli, PhD

Dr. Sylvia Morelli is an Assistant Professor of Psychology at the University of Illinois at Chicago and Director of the Empathy and Social Connection Lab. She received her BA in Psychology from Princeton University and PhD from UCLA. Prior to joining UIC, Dr. Morelli worked in the Stanford Social Neuroscience Lab and explored whether positive empathy (i.e., our ability to share and understand others' positive emotions) promotes prosocial behavior, social connection, and well-being. She uses a combination of behavioral and neuroimaging techniques, including functional magnetic resonance imaging, laboratory experiments, daily experience sampling, and social network analyses. Overall, her research aims to broaden our understanding of empathy and demonstrate its critical role in promoting well-being and positive social relationship.

The 3T MR Research Program would like to thank Dr. Morelli and her research team for submitting the following abstract.

Medial prefrontal cortex encodes idiographic representations of empathy

Abstract: Empathy is a pervasive and common human experience. As such, past work has focused on identifying a common neural signature for empathy across people. However, individuals vary in how they interpret and represent others' emotional experiences. Thus, it's possible that the subjective nature of empathy manifests in unique – not common – patterns of neural activation for each individual. To test this hypothesis, we scanned individuals (N=40) as they read 40 different stories about others' negative emotional experiences. For each experience, participants rated how much empathy they felt on a visual analog scale. We trained idiographic whole-brain models using ranked ridge regression and 5-fold cross-validation to separately predict empathy ratings for each participant. We found that these individual models reliably predicted empathy ratings (mean r = .21, std= .23, p < .001, 10,000 permutations). A univariate t-test revealed that voxels in the MPFC consistently contributed to the prediction across participants (q < 0.05 fdr-corrected) highlighting its important role in empathy computations. Interestingly, however, we did not observe any evidence of a consistent spatial similarity of the pattern in MPFC across participants (mean pairwise r = .03, ns), suggesting that each person may have a unique representation of empathy. These findings raise the possibility that empathy is an idiosyncratic appraisal, with each individual evaluating others' negative experiences in a slightly different way. Future work should further explore what factors (e.g., personal experiences, perceiver characteristics, appraisals) lead to more similar patterns of activation within the MPFC during empathy.

Task 1
In Task 1, subjects will see two-sentence descriptions of others' negative emotional experiences. The first sentence describes an unpleasant event. The second sentence indicates that the event is controllable or uncontrollable. Subjects will self-report their appraisals of how controllable the other person's situation is and their empathy (slider scales, 0-100). There are 20 controllable and 20 uncontrollable stimuli, with half of each appearing in one run, and the other half appearing in a second run. Subjects are told these experiences were taken from previous participants, who wrote letters like the one they wrote at the beginning of the study.

In pilot testing, we made sure the first sentences of the controllable and uncontrollable stimuli were matched on unpleasantness, arousal, and similarity to personal experiences. We also made sure that subjects rated the controllable stimuli as more controllable, and the uncontrollable stimuli as less controllable. The full set of stimuli are available in the Files.

Task 1 has an event-related design. We will analyze neural activity during the stimulus phase when subjects see the two sentences.

Task 2
In Task 2, subjects will see a short context sentence describing a negative emotional event followed by a photograph from www.humansofnewyork.com. The context sentences were taken from the Humans of New York captions, but they were randomly paired with the photographs (instead of retaining the original caption/photograph pairing). Subjects will self-report their appraisals of how controllable the other person's situation is and their empathy (slider scales, 0-100). There are 20 stimuli, with half appearing in one run, and the other half appearing in a second run. Before scanning, subjects will see a sample entry from www.humansofnewyork.com and how the content could be summarized in a context sentence and photo.

In pilot testing, we made sure that there was variability in controllability ratings for each stimulus and within-subjects. The full set of stimuli are available in the files.

Task 2 has an event-related design. We will analyze neural activity during the trial phase when subjects see the photos.