

ACOTUP Researcher Profile

Name of researcher: Catherine Mercier, Université Laval

Degrees and professional qualifications (including fellowships):

Postdoctoral fellow in Cognitive Neurosciences (CNRS, Lyon, France, 2005) ; Ph.D. Biomedical Sciences, option rehabilitation (Université de Montréal, 2003) ; M. Sc. Biomedical Sciences, option rehabilitation (Université de Montréal, 1999) ; B.Sc. Occupational Therapy (Université de Montréal, 1997)

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Area of research:

My research is focusing mainly on interactions between pain, body representations and motor learning. I work with various clinical populations having both motor impairments and pain, such as individuals with a spinal cord injury, amputation, complex regional pain syndrome, musculoskeletal injury, etc. I use a variety of methodological approaches to assess these aspects at the clinical as well as at the behavioral and neurophysiological levels, using approaches such as non-invasive brain stimulation, quantitative sensory testing, brain imaging, electrophysiology, robotics, virtual reality, movement analysis, etc. Of course, this is achieved thank to strong interdisciplinary collaborations. The long-term goal of my work is to identify new strategies to address pain and motor impairments in a more integrated manner, as these two problems very often co-occur in physical rehabilitation.

Research related awards and honor:

- Senior FRQS Scholar (2014-18)
- CIHR New Investigator (2010-15)
- Junior 2 FRQS Award (2010-14)
- Junior 1 FRQS Award (2006-10)
- AQIPA-CCSST Award for basic research in the field of amputees rehabilitation (2012)

Grants/funding history:

- Roy JS, Mercier C, Bouyer LJ. (2015-20) Comprehensive assessment of musculoskeletal disorders: from the laboratory to the workplace. Canada Foundation for Innovation, John R. Evans Leaders Fund, (310 298\$)
- Mercier C, Bouyer LJ, Roy, JS. (2013-18) Effect of pain on motor learning: Neural mechanisms and implications for rehabilitation, Canadian Institutes of Health Research, Operating grant, (603 290\$).
- Mercier C. (2012-19) Effect of acute pain on the plastic potential of the sensorimotor cortex. Natural Sciences and Engineering Research Council of Canada, Discovery grant, (175 000\$).
- Jackson P & Mercier C. (2007-09) Using neuroimaging and neurostimulation to understand and optimize brain plasticity in rehabilitation. Canada Foundation for Innovation, Leaders Opportunity Fund, (599 675\$).
- Mercier C. (2006-10) Relationship between amputation-induced plasticity and motor control of the phantom limb. Canadian Institutes of Health Research, Operating grant, (167 125 \$).

Research collaboration:

I believe that interdisciplinary collaboration is the only way to solve the complex and challenges that we are facing in rehabilitation, as well as to take the best advantage of the technologies that are available. At my research center in Quebec City, I have close collaborations with researchers from various fields

including physical therapy, kinesiology, neurophysiology, neuropsychology and engineering. I also collaborate with clinical and basic science researchers through several provincial and national teams or networks. At the international level, I currently have active collaborations with France (Dr. Karen Reilly; post-amputation plasticity and pain), UK (Dr. Candy McCabe; interactions between pain and body perception in complex regional pain syndrome, fibromyalgia and osteoarthritis), Australia (Dr. Paul Hodges; impact of muscle pain on motor learning) and Colombia (Dr. Nathalie Charpak; long-term impact of kangaroo mother care on brain development). Finally, I recently started some collaborations with industry in the field of rehabilitation robotics and virtual reality.

What is the most important thing in mentoring graduate students?

I supervised about 20 graduate students and post-doctoral trainees since 2005. Having new brilliant, creative and highly motivated young investigators joining my lab every year is certainly one of the most stimulating aspects of my job. I would say that the most important aspect in mentoring research trainees is to be able to adapt and tailor your approach to individual needs and strengths/weaknesses. As a mentor, I feel that my role is to help each of my trainees to achieve his own goals, not to push everybody to follow the same path. I think that another important aspect is to realize that being a successful researcher is not limited to having theoretical and methodological expertise. I try to provide my trainees with opportunities to develop management, collaboration and communication skills for example, that are all very important for their future career inside or outside the academia. In order to build their network, I also encourage them to attend to conferences, to get involved in committees, to interact with stakeholders and I give them the opportunity to work with some of my local, national and international collaborators.

Most significant publications:

It is difficult to select so I tried to choose some that cover different components of my research program.

1. Bouffard J, Bouyer LJ, Roy JS, Mercier C. Tonic pain experienced during locomotor training impairs retention despite normal performance during acquisition. *J Neurosci*. 2014, 34(28):9190-5.

In this paper, we showed that applying local tonic cutaneous pain during training in a locomotor adaptation task interferes with the retention, despite the fact that baseline gait and motor acquisition were apparently unimpaired. This result, suggesting that the same physical rehabilitation could be less effective if administered in the presence of pain, is important given that pain prevalence is particularly high in acute/subacute stage after an injury, at the moment at which people undergo motor rehabilitation.

2. Jetté F, Meziane HB, Mercier C. Effect of motor cortex rTMS on neuropathic pain after spinal cord injury. *Neurorehabil Neural Repair*. 2013;27(7):636-43.

This study shows that repetitive transcranial magnetic stimulation (rTMS) applied to motor cortex decreases neuropathic pain in patients with spinal cord injury, regardless of the motor region stimulated and of the changes in cortical excitability, suggesting that the analgesic effect is not associated with local changes but rather probably relies on distant areas driving descending inhibition. This was the first study from my lab in which we used non-invasive brain stimulation for treatment purpose, and we are now conducting several studies to see whether it can prime the effect of different rehabilitation interventions.

3. Mercier, C., Sirigu, S. Training with virtual visual feedback to alleviate phantom limb pain. *Neurorehabil Neural Repair* 2009;23:587-94.

In this study, we used a simple virtual reality system in individuals with hand amputation to trick their brain into thinking that the hand is still there and can move, and showed that such approach can result in clinically significant decreases in phantom pain. We are now using more sophisticated virtual reality systems to try to transfer these findings to other clinical populations, such as people with spinal cord injury, complex regional pain syndrome and low back pain.

Tips you would give for new investigators:

- Find mentors that are supportive, but that can as well be critic and honest toward you. Make sure to prepare your grant applications sufficiently in advance in order to get meaningful feedback.

- Collaborations are a key aspect in research. Seek collaborators that you enjoy working with (it will make your job much more fun!) and that have complementary expertise (rather than working with people that are very close to your field). Make sure to be a good and reliable collaborator yourself: this will increase your chances that people seek your collaboration in the future.
- Include your stakeholders in your research from the start, it will make knowledge translation efforts much more successful and will bring valuable insight to your research. Also keep in mind that reciprocity is important to build long-term partnership.
- Make research trainees a priority: they are key to the success of your research program. A good reputation as a supervisor will impact on your capacity to attract new trainees.
- Learn to say no. At the beginning everything seems like a unique opportunity, but early in your career it is very important to remain focused on the development of your own research program.
- Take time to think about your long-term research plan and shorter-term objectives. Revise your plan on a regular basis, it will help you to make sure that you keep the focus on your priorities.

Resources/supports/training programs for new investigators:

<http://www.hhmi.org/programs/resources-early-career-scientist-development>

http://www.cihr-irsc.gc.ca/e/documents/ig_guide_for_new_pis_e.pdf