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Through the eyes of neuroimaging : the impact of mindfulness on breast cancer patients with neuropathic pain

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ABSTRACT

Neuropathic pain is defined as “pain initiated or caused by a primary lesion or dysfunction in the nervous system.”¹ It is estimated that 22,700 women were diagnosed with breast cancer in 2012.² With increased screening, early diagnosis, and advances in treatments, mortality rates have been decreasing.² Despite these accomplishments, however, there now lies a “large cohort of breast cancer survivors with residual symptoms such as fatigue, cognitive problems, and fear of recurrence”.² Also, the prevalence of the relationship between breast cancer survivors and chronic neuropathic pain remains to be completely understood within its entire context. Therefore, in an attempt to reduce these symptoms, our main objective is to provide empirical evidence, using innovative methodology, such as fMRI and DTI, to show that neuropathic pain can be perceived differently and quality of life can improve following a Mindfulness – Based Stress Reduction (MBSR) program. More specifically, we are investigating whether participation in an MBSR program will result in altered patterns of neuronal activity, increased white matter integrity, and changes in the biomarkers of stress in breast cancer survivors with chronic neuropathic pain. We expect this approach to dramatically reduce the perception of pain amongst breast cancer survivors and increase quality of life. This will then open discussion into traditional and alternative methods of post treatment.

PURPOSE

1. Evaluate the effects of Mindfulness-Based Stress Reduction (MBSR) on disability, psychological distress, and quality of life among breast cancer survivors with chronic neuropathic pain (CNP)
2. Investigate whether participation in MBSR results in altered patterns of neuronal activity, increased white matter integrity, and changes in biomarkers of stress in breast cancer survivors with CNP

INTRODUCTION

- Chronic neuropathic pain is a problem that is receiving increasing attention in breast cancer survivors as the incidence of CNP following surgery in breast cancer survivors is estimated at over 50%.^{3,4}
- Examples of CNP in cancer patients post-surgery include phantom breast pain, painful neuroma, and intercostobrachial neuralgia.^{3,4} Patients with persistent chronic neuropathic pain often require the combination therapy of an antidepressant, anticonvulsant and an opioid analgesic.
- Despite the availability of appropriate medical therapy, clinical management is often wanting due to inadequate diagnosis or management of co-morbid conditions, and lack of understanding of treatment options.^{5,6}
- Therefore the creation of an interdisciplinary program for the patient which addresses both biological and psychosocial processes is optimal as it ensures that the patient receives appropriate treatment.

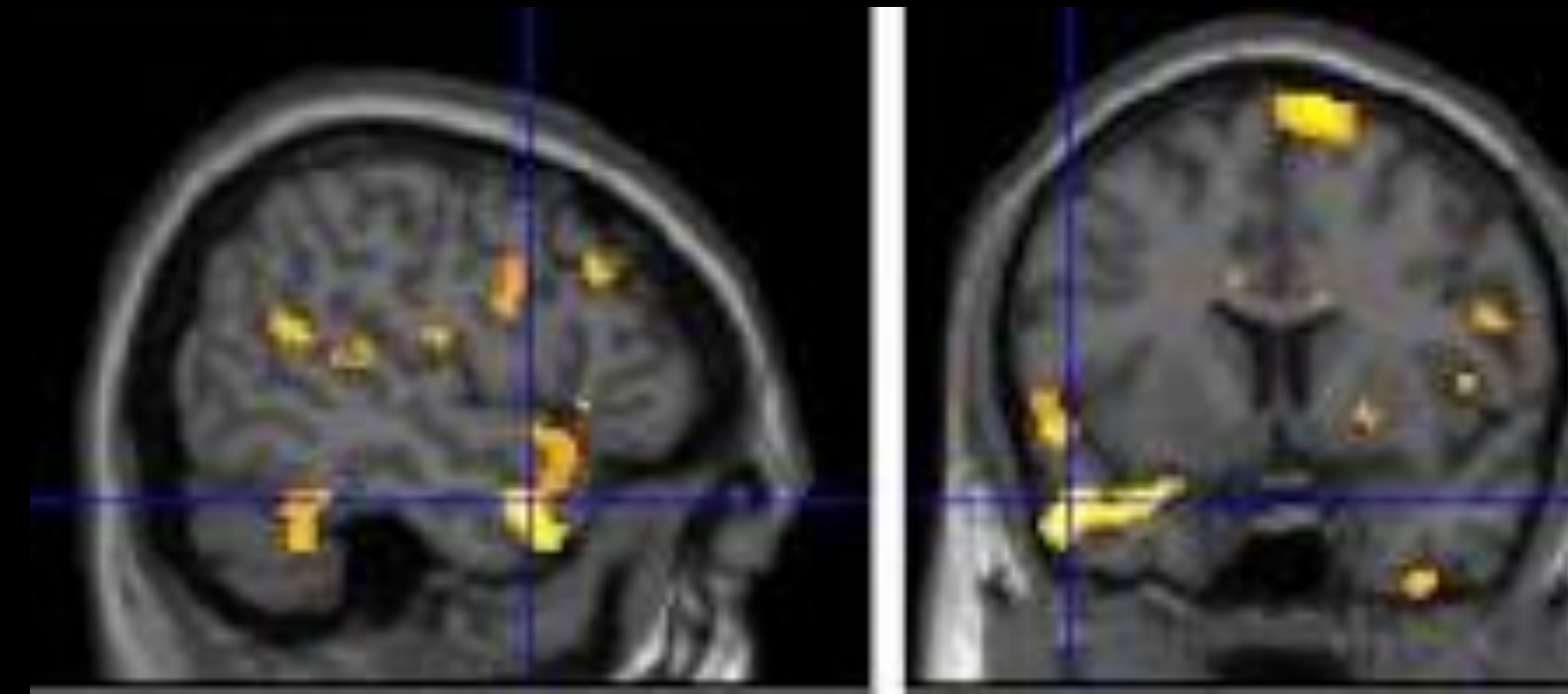
HYPOTHESIS

- Patients within the “Mindfulness Based Stress Reduction” group will have 30% more responders than the wait-list control group in the third month of follow up after treatment.
- We expect that through imaging sessions performed before the MBSR and three months afterwards, MBSR will have a significant reduction in the amount of chronic neuropathic pain perceived by patients, thereby improving the participant’s quality of living.
- We anticipate that there will also be improved, strengthening changes in the structural white matter and neural integrity of the participants post MBSR treatment. (measured through neural B.O.L.D activity, cortical thickness, functional, and structural connectivity).
- We hypothesize that there will be significant changes in patterns of neural activation following MBSR, specifically in the somatosensory cortex , prefrontal cortex, anterior cingulate cortex, and insula.

METHODOLOGY

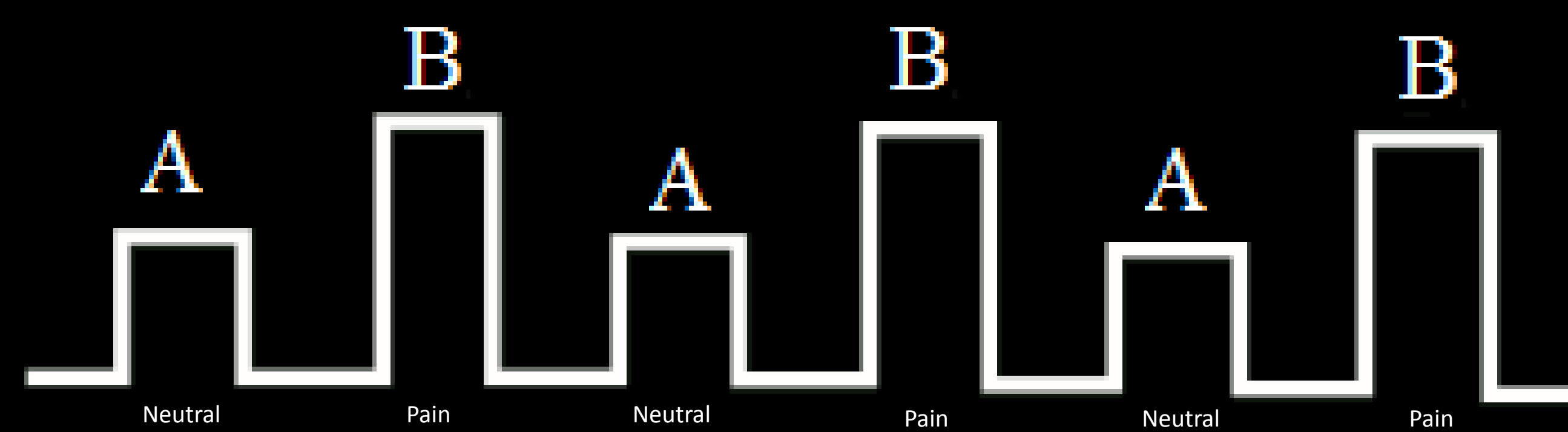
FUNCTIONAL MAGNETIC RESSONANCE IMAGING (FMRI)

- fMRI imaging is a non-invasive neuroimaging technique that measures levels of oxygen through the blood flow in the brain during cognitive and behavioral tasks.
- We use fMRI to examine the effects of mindfulness based stress reduction prior to treatment and post exposure by examining the changes in blood flow during emotional and neutral Stroop tasks.
- Participants undergo a 1-hour MRI session on the 3T Siemens TRIO scanner at the Ottawa Hospital that includes a high resolution structural scan, 1 fMRI task, a resting state scan, and a DTI sequence.

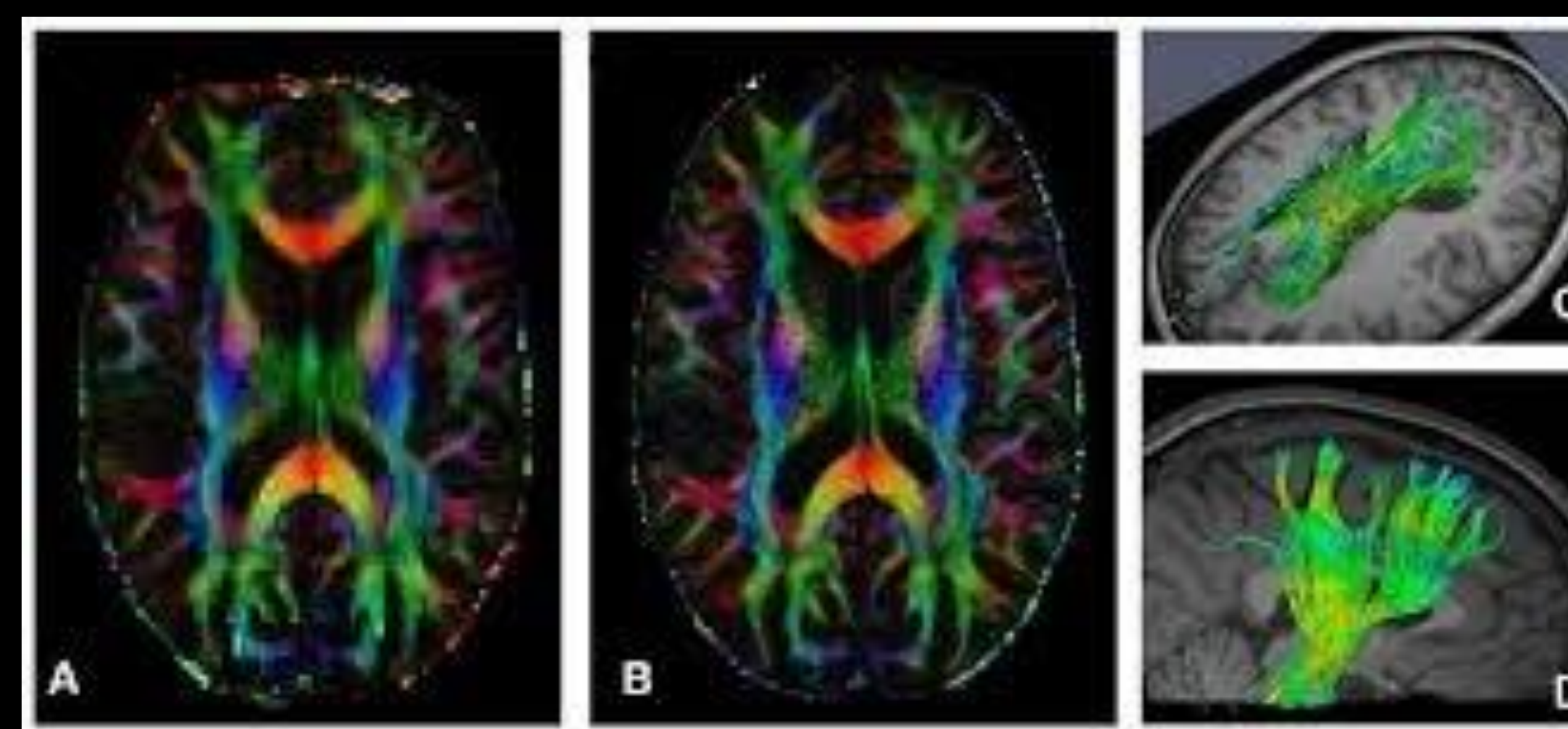


EMOTIONAL STROOP TASK

- Similar to the original Stroop task, the emotional Stroop test examines the time it takes for the participant to name colours of negative emotional words as opposed to the neutral words.⁷
- For our purposes, four emotionally neutral word blocks are employed as a base control as well as four emotional painful word blocks. Responses to both conditions are measured on a response pad that the participant uses while in the fMRI unit .
- Instructions tell the participant to respond to the colour of the ink of the corresponding word.



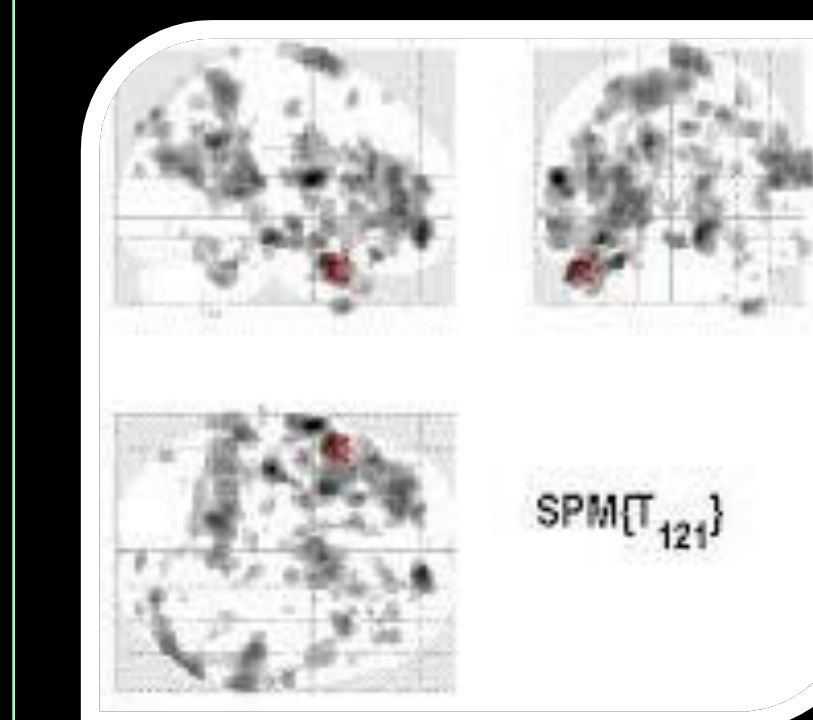
DIFFUSION TENSOR IMAGING



Medical University of Graz (Neuroimaging Research Unit). (2012). High resolution diffusion tensor imaging [Image]. Retrieved from <http://www.neuroimaging.at/pages/research/high-resolution-dti.php>

MINDFULNESS BASED STRESS REDUCTION (MBSR)

- A Mindfulness-based stress reduction (MBSR) is a group-based intervention that focuses on improving awareness and acceptance of moment-to-moment experiences, including physical discomfort and difficult emotions.^{8,9}
- One of the main components of MBSR includes tackling multiple approaches to mindfulness exercises that serve to increase awareness to sensations, feelings, and thoughts. Examples of mindfulness practices include the body scan, sitting meditation, yoga, and mindfulness walking among others.
- They also allow the participant to provide self-regulation strategies, and promote their own healthy and adaptive responses to stress.
- An educational component is incorporated into MBSR which involves teaching the participant about stress and also includes group discussions. The MSBR program typically requires 8 weekly, 2 to 2.5-hour sessions - including 1-day of intensive practice.



STATISTICAL PARAMETRIC MAPPING (SPM 8)

- The functional brain imaging data received from the fMRI scans are post-processed and analysed using Statistical Parametric Mapping 8 (SPM8)
- Statistical parametric mapping is used to identify regionally specific effects in neuroimaging data and it is a prevalent approach to characterizing functional anatomy, more specifically fMRI.¹⁰
- Using a voxel-based approach, statistical parametric mapping tries to address a relationship about regionally specific responses in experimental factors.¹⁰ Data collection and analysis is still underway for this study.

REFERENCES

1. Bogduk, N. & Merskey, H. (1994). Classification of chronic pain: descriptions of chronic pain syndromes and definitions of pain terms (2nd ed). Seattle, WA: IASP Press.
2. Canadian Cancer Society's Steering Committee on Cancer Statistics.(2011). Canadian Cancer Statistics 2011. Toronto, ON: Canadian Cancer Society.
3. Jung, B. F., Ahrendt, G. M., Oaklander, A. L. & Dworkin, R. H. (2003). Neuropathic pain following breast cancer surgery: proposed classification and research update. *Pain*, 104, 1-14.
4. Stevens, P. E., Dibble, S. L., & Miaskowski, C. (1995). Prevalence, characteristics and impact of postmastectomy pain syndrome: an investigation of women's experiences. *Pain*, 61(1), 61-68.
5. Richeimer, S. H., Bajwa, Z. H., Kahraman, S. S., Ransil, B. J., & Warfield, C. A. (1997). Utilization patterns of tricyclic antidepressants in a multidisciplinary pain clinic: A survey. *Clinical Journal of Pain*, 13(4), 324-329.
6. Gore, M., Dukes, E., Rowbotham, D. J., Tai, K. S., & Leslie, D. (2007). Clinical characteristics and pain management among patients with painful neuropathic disorders in general practice settings. *European Journal of Pain*, 11(6), 652-664.
7. Hogan, R., Gotlib, I. H., & McCann, C. D. (1984). Construct accessibility and depression: An examination of cognitive and affective factors. *Journal of Personality and Social Psychology*, 47(2), 427-439.
8. Kabat-Zinn. (1990). *Full catastrophe living: using the window of your body and mind to face stress, pain, and illness*. New York: Delacourt.
9. Shapiro, S. L. & Carson, L. E. (2009). *The art and science of mindfulness: integrating mindfulness in psychology and the helping professions*. Washington, DC: American Psychological Association.
10. Penny, W. D., Friston, K. J., Ashburner, J.T., Kiebel, S.J & Nichols, T. E. (2006). *Statistical parametric mapping : the analysis of functional brain images*. San Diego: Burlington Academic Press.

