CONNECTING THE DOTS

Pain, Depression and Cognitive Impairment

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??? QUESTIONS ???

- Why do a significant percent of depressed and/or chronic pain patients report cognitive deficits without evidence of brain injury?

- Why do a significant percentage of MVA clients with mTBI still report cognitive symptoms months or years after the trauma?

"Traumatic brain injury is an event not an explanatory diagnosis." *(Silver, J.M., 2014)*

ASSUMPTIONS

- **PAIN** = physical and/or psychological
- **DEPRESSION** = common emotional response to persistent pain
- **COGNITIVE IMPAIRMENT** = brain injury, traumatic (TBI) or natural (ie. aging)

Neuromatrix

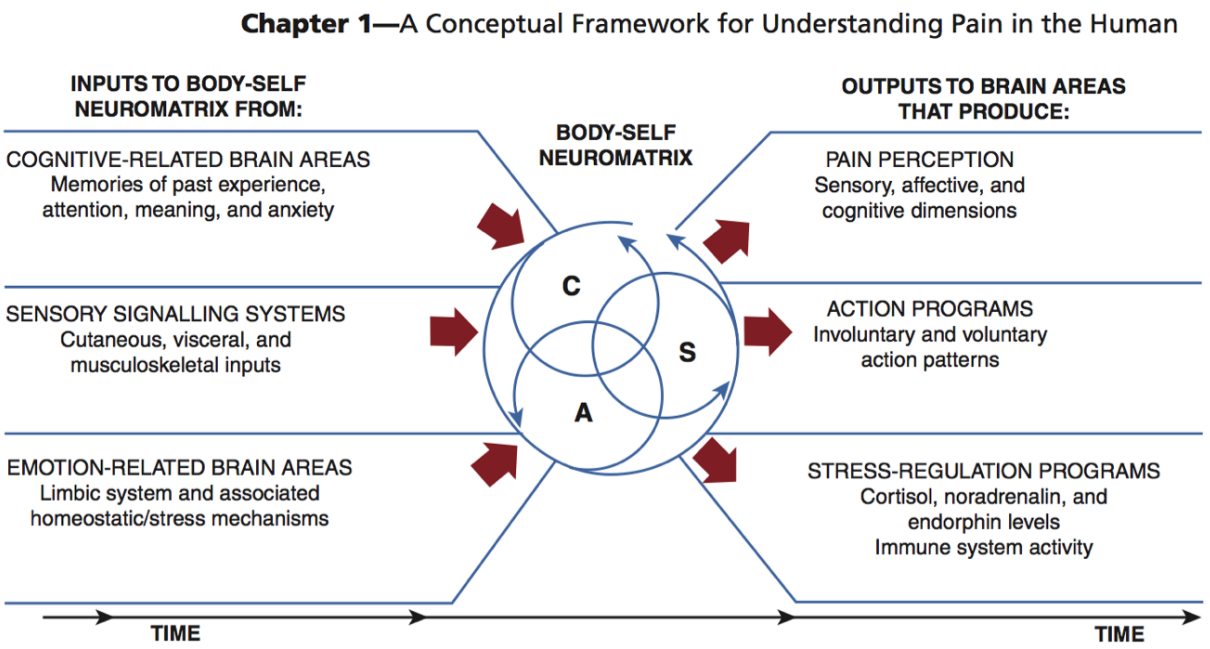
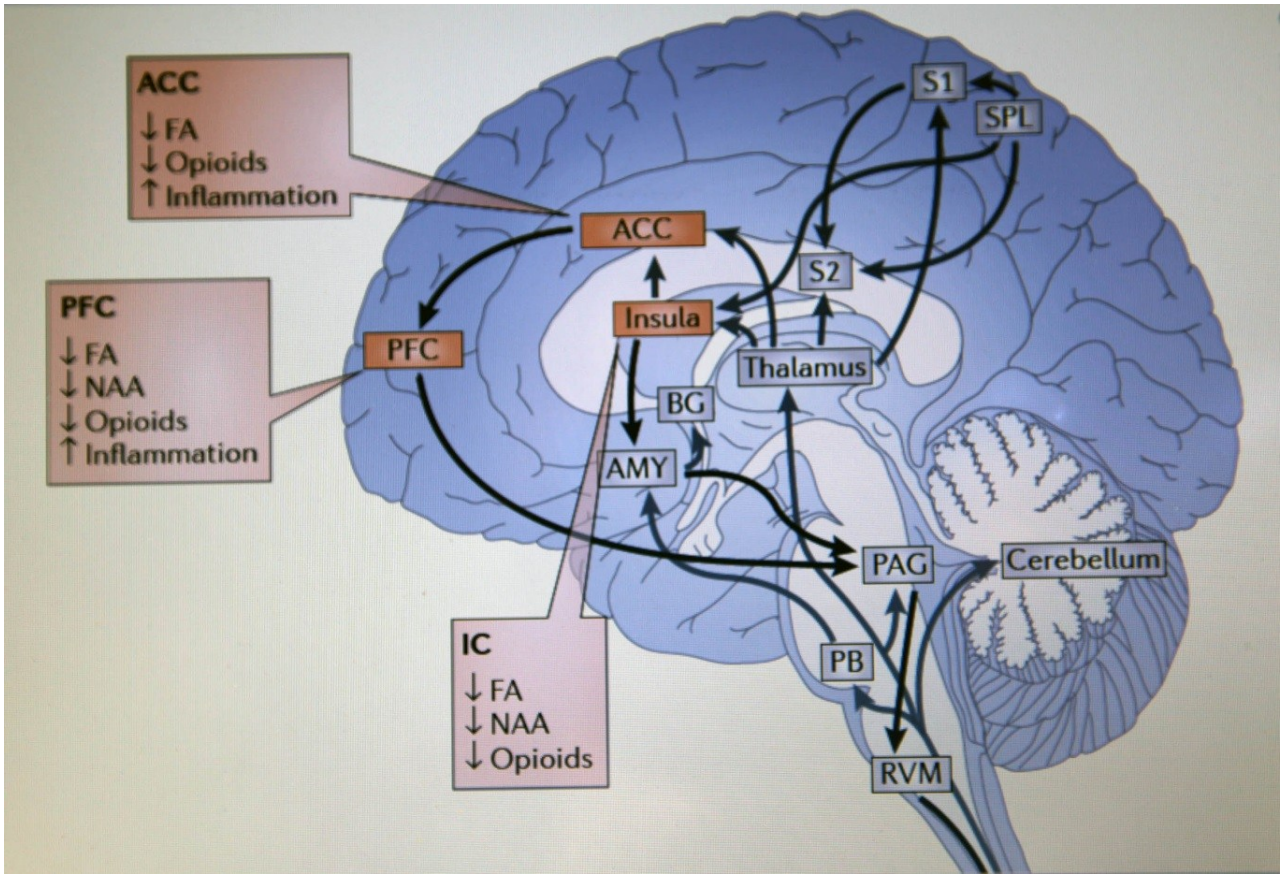


Fig. 1.3 Factors that contribute to the patterns of activity generated by the body-self neuromatrix, which is composed of sensory, affective, and cognitive neuromodules. The output patterns from the neuromatrix produce the multiple dimensions of pain experience, as well as concurrent homeostatic and behavioral responses. *(From Melzack R: Pain and the neuromatrix in the brain,* J Dent Educ *65:1378–1382, 2001.)*

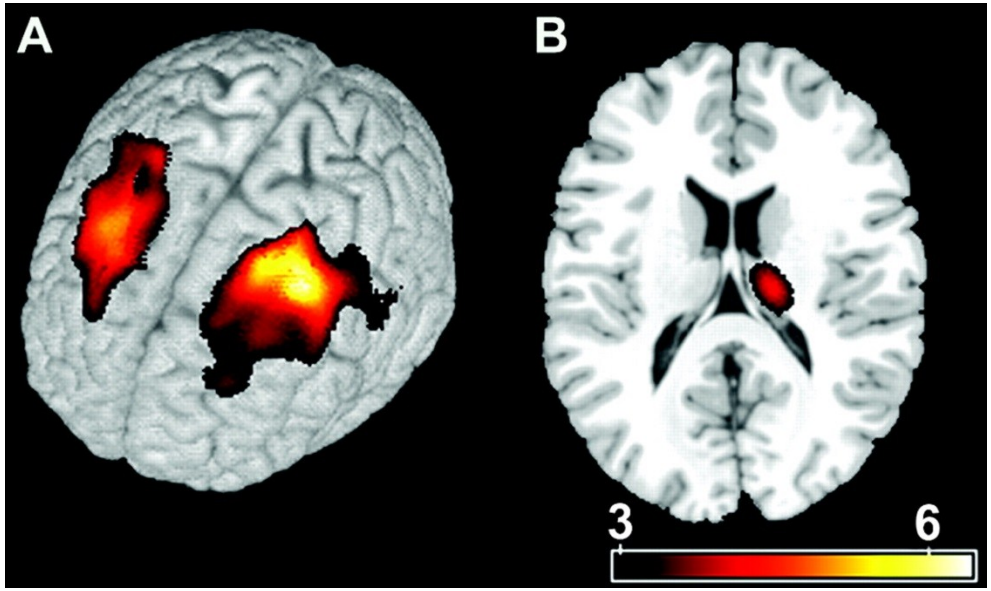
IMAGE: Updated Neuromatrix Model. Waldman SD; Pain Management, 2nd Ed. (Saunders) 2011
p. 5. Ch. 1: A Conceptual Framework for Understanding Pain in the Human. Joel Katz and Ronald Melzack

Chronic Pain physiology-areas



Consistently identified changes in the brains of patients with chronic pain
ACC=anterior cingulate cortex, **PFC**=prefrontal cortex, **IC**=insula

Gray matter decreases in CBP



Regional gray matter density decreases in chronic back pain (CBP) subjects. A nonparametric comparison between CBP and control subjects is shown.

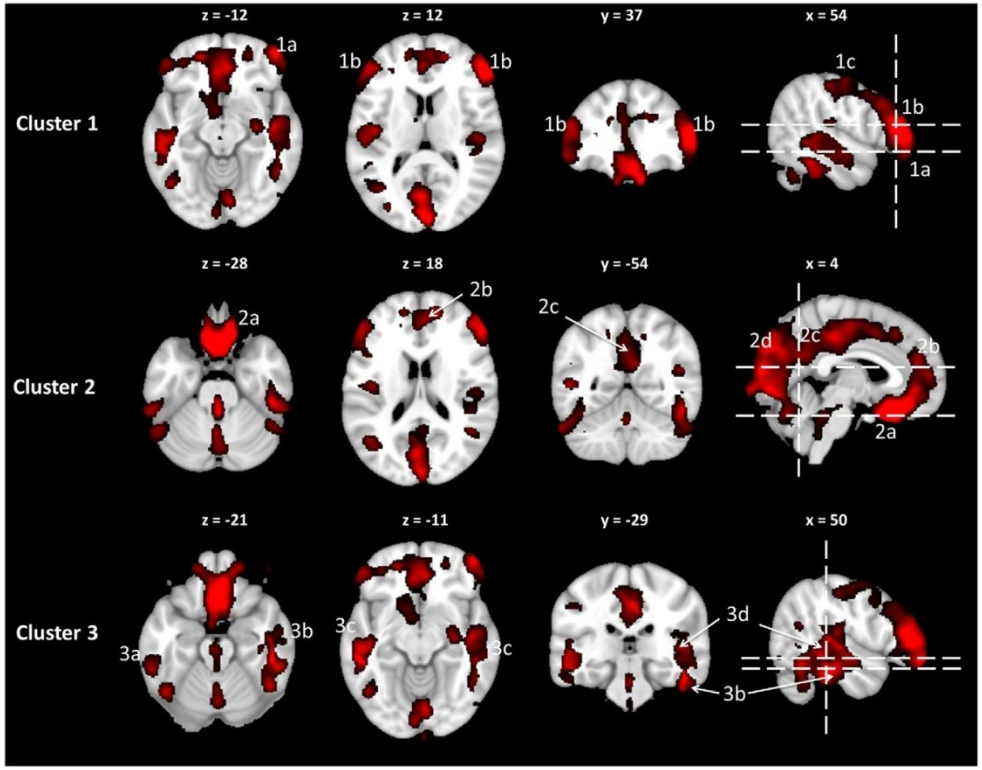
Gray matter density is bilaterally reduced in the DLPFC. A nonparametric comparison limited to the thalami revealed a significant decrease in gray matter density in the right anterior thalamus

Apkarian et al. J. Neurosci. 2004;24:10410-10415

Gray Matter Changes

- **Fibromyalgia**: decrease in gray matter volume was 3 times that of age-matched controls (Kuchinad et al., 2007)
- **Temporomandibular joint (TMJ)** (Younger et al, 2010, Moayedi et al, 2011)
- **Migraine** (Schmidt-Wilcke et al., 2008)

Gray Matter & Depression



Grieve S.M. et al, ***Widespread reductions in gray matter volume in depression,*** Neurolmage:Clin, 2013, 3, 332-339

Fig. 1. Voxel based morphometry volume differences between the MDD and control groups (MDD b controls at p b 0.05 FDR-corrected).
The dominant three bilateral clusters are shown in two axial slices (columns 1 & 2).

“Given that normal whole-brain gray matter atrophy is 0.5% per year of aging and that atrophy caused by CBP is 5-11%, the magnitude of brain gray matter atrophy caused by CBP is equivalent to 10-20 years of aging”

(Apkarian et al, 2004).

“The results are consistent with the hypothesis that **anti-inflammatory drugs** may provide protection against age-related decreases in brain volume.”

(Walther et al, 2011)

Post-Concussive Syndrome (PCS)

- Cognitive difficulties
  - Attention/concentration, memory
- Affective (emotional) difficulties
  - Irritability, anxiety, depression
- Physical (somatic) complaints
  - Headache, dizziness, sensory sensitivity (ie. sound, light)

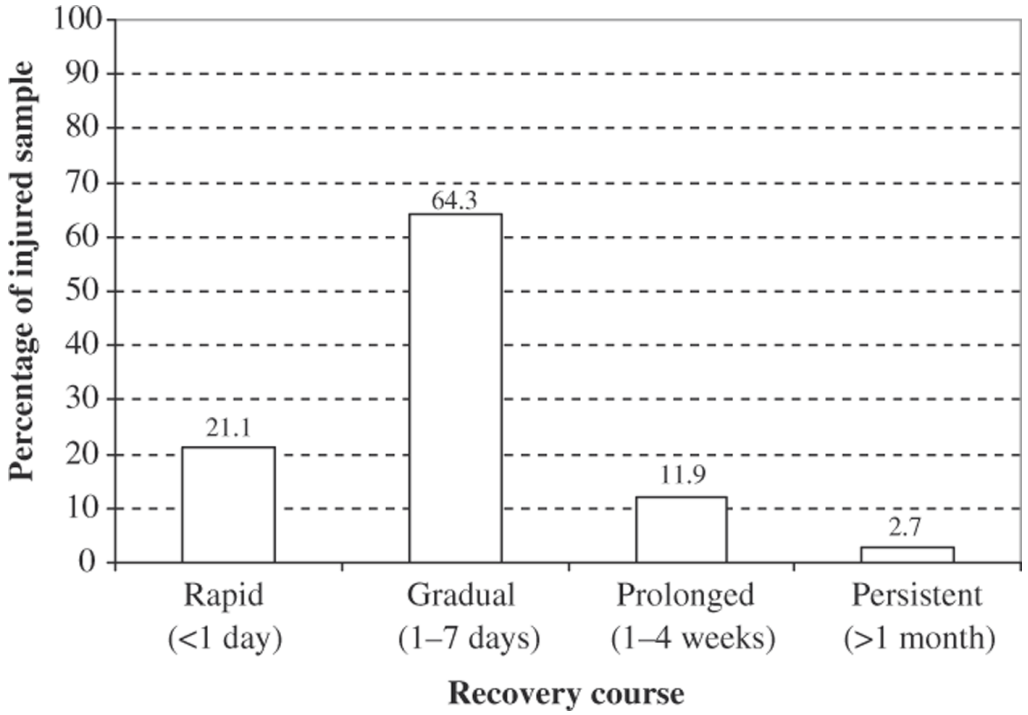
mTBI Recovery

Table 1
Acute and long-term cognitive sequelae of TBI by levels of severity

	Mild TBI	Moderate-Severe TBI
Acute		
Loss of consciousness (min)	0–30	>30
Posttraumatic amnesia (h)	0–24	>24
Subacute and long-term		
Memory Attention Processing speed Executive functions	Resolves rapidly within 80%–85% patients[2,10–12] May persist in w15% of patients[13]	Persists in w65% of patients[8] Can include deficits of awareness, reasoning, language, visuospatial processing, and general intelligence[14–16]

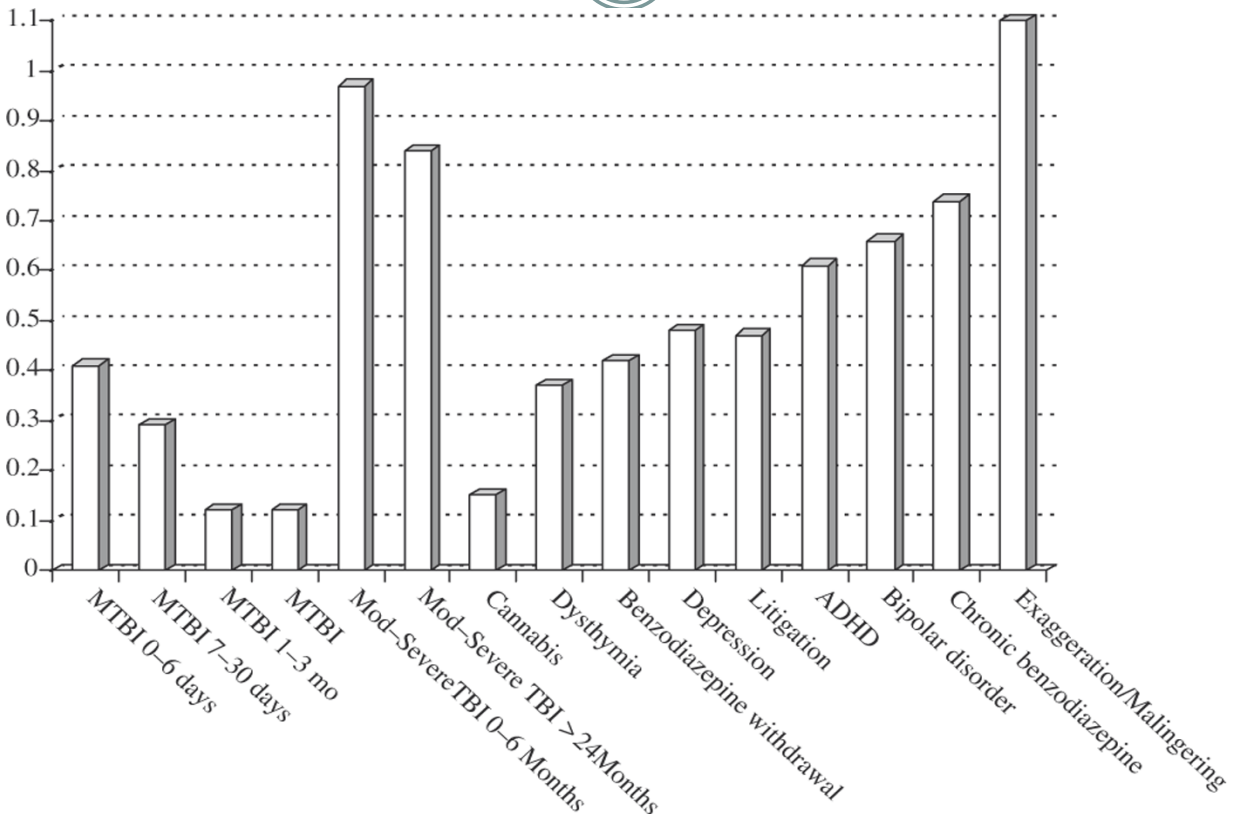
Rabinowitz, A.R. & Levin, H.S., *Cognitive sequelae of traumatic brain injury*, Psychiatr Clin N Amer, 2014; 37, 1-11

mTBI Recovery Course



Post-injury symptom recovery in 635 concussed high school and college athletes. (McCrea et al, 2009)

Neuropsychological Functioning Comparison



Effect size of factors affecting neuropsychological functioning.
.2=mild effect, .5=moderate, .8=large.
(McCrea et al. , 2009)

Why persisting symptoms in MVA clients with mTBI?

- **Litigation?**
  - malingering-little support in the literature.
  - litigation selects serious injuries.
- **Co-Morbidities**:
  - Pain
  - Depression, Anxiety

Diagnosing Depression & PCS

- Challenges:
  - Diagnostic symptoms of depression similar to PCS: diminished concentration, indecisiveness, loss of energy, irritability, strained social relationships
  - Depression is common with co-morbidities that frequently coexist with PCS (ie. pain, PTSD)
  - Patients with depression are expected to have cognitive complaints.

"Perceived cognitive impairment is a cardinal feature of depression." (Lange et al. 2011)

Depression & Cognitive symptoms

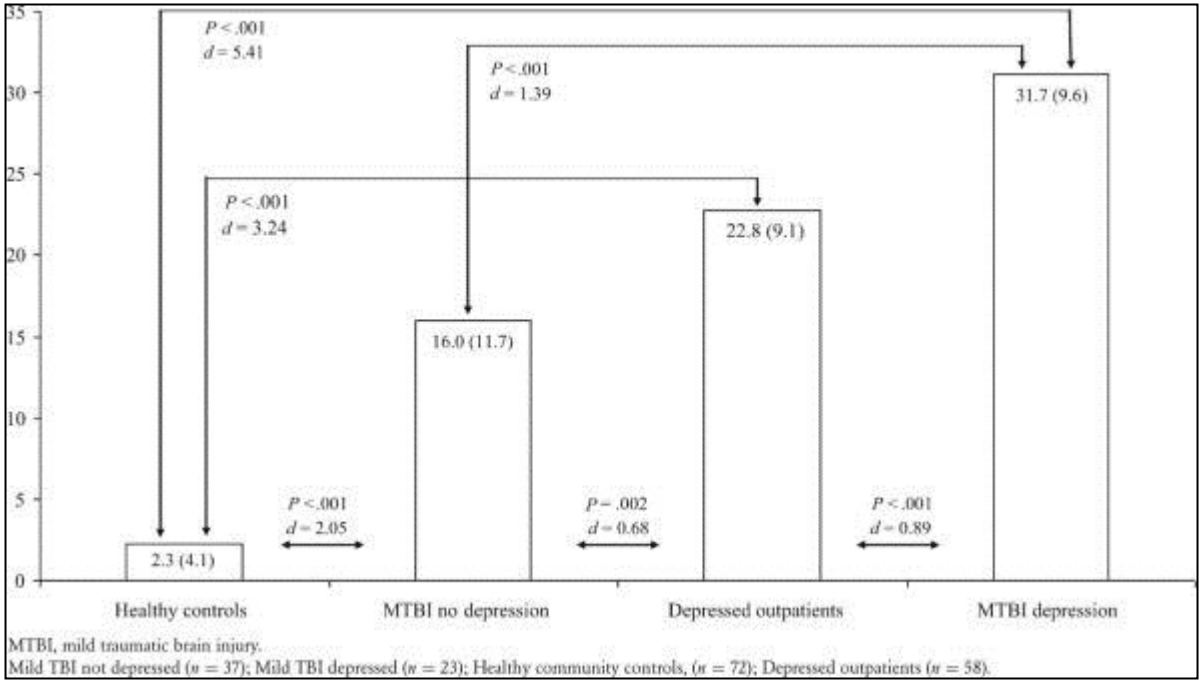


Figure 1 . Mann-Whitney U tests and Cohen's effect sizes for British Columbia Post-concussion Symptom Inventory total scores by group.

Depression Strongly Influences Postconcussion Symptom Reporting Following Mild Traumatic Brain Injury.

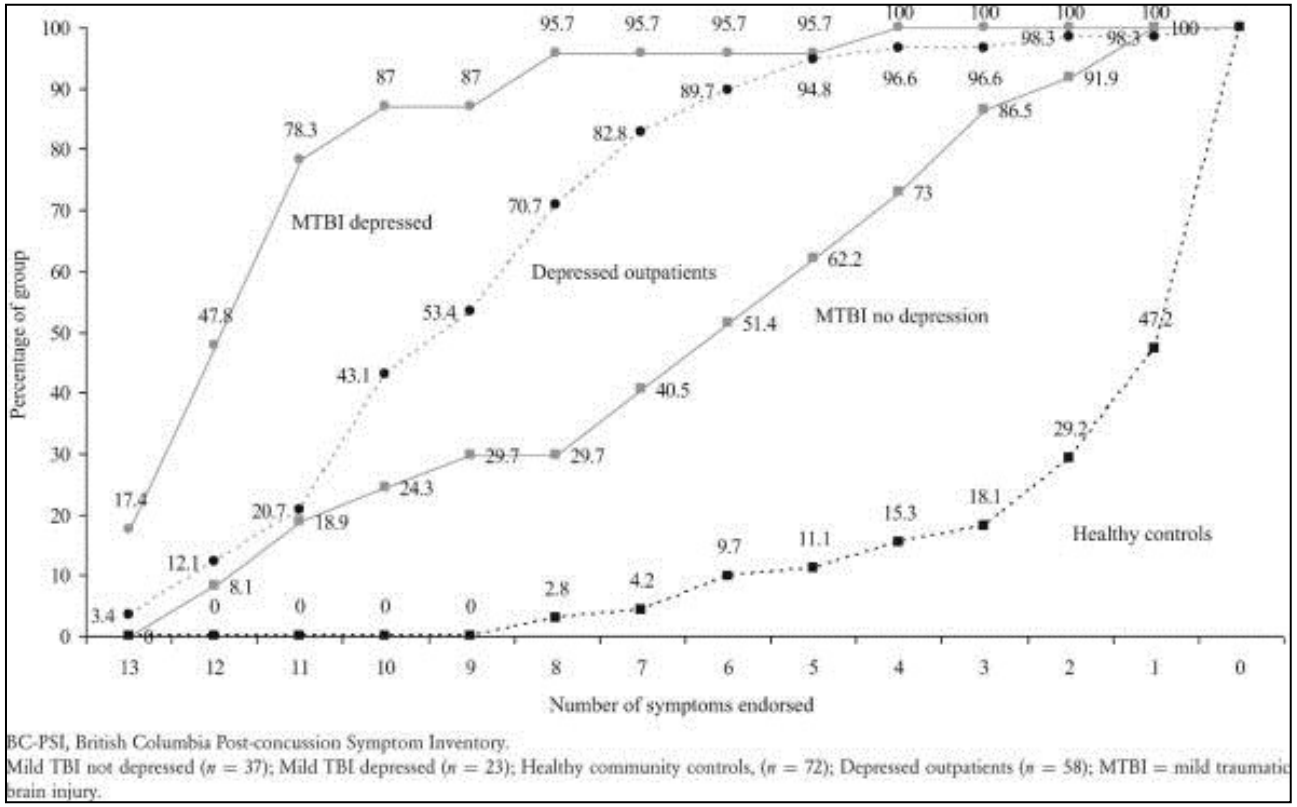
Journal of Head Trauma Rehabilitation. 26(2):127-137, March/April 2011.

CONCLUDE

1. Pain and emotional response are related to physiological and structural changes in the brain which may explain cognitive difficulties.

2. The effect of pain and emotional response on cognition likely explain persisting “PCS” symptoms in mTBI after MVA

Depression & cognitive symptoms



BC-PSI, British Columbia Post-concussion Symptom Inventory.
Mild TBI not depressed ($n = 37$); Mild TBI depressed ($n = 23$); Healthy community controls, ($n = 72$); Depressed outpatients ($n = 58$); MTBI = mild traumatic brain injury.

Figure 2 . Cumulative percentages of the number of symptoms endorsed on the BC-PSI by group: Mild or greater symptoms.

Depression Strongly Influences Postconcussion Symptom Reporting Following Mild Traumatic Brain Injury. Journal of Head Trauma Rehabilitation. 26(2):127-137, March/April 2011.

Treatment-Depression

- Talk therapy (CBT, Mindfulness, CPT)
- Medication
  - Cognitive effects
  - Placebo – Dr. I. Kirsch, Harvard Medical School
    - Only 14% due to drug.
    - NHS in Great Britain – Exercise for mild/moderate depression

Treatment-Pain

- Counselling:
  - Education
  - CBT, CPT
  - Mindfulness meditation
- Physical:
  - Physiotherapy, massage, chiropractic
  - Medication incl. nerve block, Botox inj.
  - Rehabilitation exercise

Treatment-Pain (cont'd)

Soldiers Get Virtual Reality Therapy for Burn Pain.mp4

Meditation & Morphology

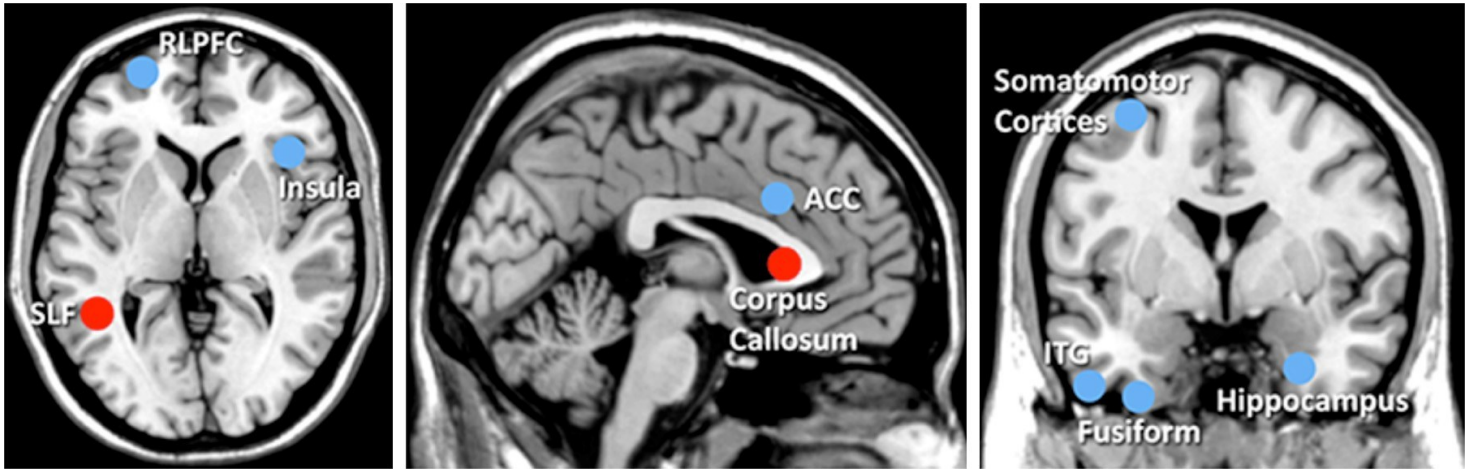


Fig. 1. Convergent brain structure differences in meditation practitioners. Note: Convergent findings from all morphometric studies of meditation practitioners (from both long-term practitioners and novices undergoing short-term training). Regional labels are approximate, and are shown for illustrative purposes only. Blue circles: gray matter regions; red circles: white matter pathways. ACC: anterior/mid cingulate cortex; ITG: inferior temporal gyrus; RLPFC: rostrolateral prefrontal cortex; SLF: superior longitudinal fasciculus.

Fox, K.C.R. et al. ***Is meditation associate with altered brain structure? A systematic review and meta-analysis of morphometric neuroimaging in mediation Practitioners.*** Neuroscience and Biobehavioral Reviews, 2014, 43, 48-73

Treatment(cont'd)

- Video/Computer games – remote control "toys"
  - Distraction for pain
  - Self-reinforcing
  - Cognitive benefits:
    - Attention
    - Memory
    - Concentration
    - Planning/follow-through

Treatment (cont'd)

- Relaxation/Meditation/Yoga
- Supplements:
  - Magnesium (pill or Epsom salts baths)
  - Fish oil
- Cardiovascular exercise
    - Mood: depression/anxiety/anger
    - Improved blood flow to brain
    - Reduces fatigue, increases cognitive abilities

Future-Treatment

- Use of functional imaging to:
  - a) “fine-tune” current treatment strategies
  - b) validate emerging treatments

Future-Diagnosis

- Greater understanding – brain changes both structurally and physiologically with pain and emotionality.
- Objective evidence of pain through imaging of structural changes?
- BIOMARKERS such as S100B (Jeter, C.B., *Biomarkers for the diagnosis and prognosis of mild traumatic brain injury/concussion. J. of Neurotrauma, 2013, 30, 657-670)*

Thank you and a special thanks to Mary Friesen, B.A., M.Psy. (cand.)

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Pain, Perceived Injustice, and Relationship to Self-Rated Disability in Individuals with Motor Vehicle Collision Injuries

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BACKGROUND AND OBJECTIVES

Anecdotal clinical observations and research have noted that perceptions of injustice are associated with both increased pain and disability. The aim of the present study is to examine pain, perceived injustice, and psychological variables in relation to self-reported disability in individuals who sustained motor vehicle collision injuries.

Objectives:

1) To investigate whether participants who perceive themselves responsible for the collision differ from those who perceive someone else is responsible for the collision on pain and psychological variables;
2) To investigate whether participants who score high on perceived injustice differ from those participants who score low on perceived injustice on pain and psychological variables;
3) To investigate the relationship of psychological variables as predictors of pain disability

METHODS AND PARTICIPANTS

Sample:

- Total sample (n = 30): Participants are adult clients who were referred for psychological assessment and/or psychological counselling.

Data abstraction:

After obtaining ethics approval and informed consent, participants completed the following:

- Injustice Experience Questionnaire (IEQ);
- Beck Anxiety Inventory (BAI);
- Beck Depression Inventory–II (BDI-II);
- Clinical Anger Scale (CAS);
- Short-Form McGill Pain Questionnaire–2 (SF-MPQ-2);
- PTSD Checklist (PCLC);
- Pain Catastrophizing Scale (PCS);
- Pain Disability Index (PDI);
- Rated thresholds to sensation of heat pain detection using a Medoc Thermal NeuroSensory Analyzer;
- Rated perceived responsibility of motor vehicle collision.

Low and high groups of perceived injustice:

Perceived injustice was dichotomized as low or high based on median split of IEQ scores. In this study IEQ median = 36.5.

Responsibility for collision:

All participants attributed responsibility for the collision to someone else; therefore, an analysis of participants based on attribution of responsibility (self-responsible or other-responsible) was not possible.

Sample Characteristics

Heat pain thresholds were significantly lower in women (n = 10) (M = 42.8, SD = 3.4) than men (n = 17) (M = 46.8, SD = 2.5), t (25) = 3.5, $p < .01$, $r = .57$. There were no gender differences on any of the psychological variables or in length of time since motor vehicle collision.

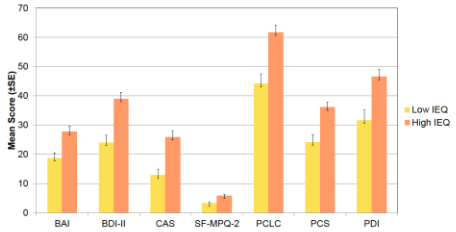
RESULTS

Means and Standard Deviations on Low and High Groups of Perceived Injustice (IEQ)

MEASURES	LOW IEQ (n = 15)	HIGH IEQ (n = 15)	p VALUE
HEAT PAIN	46.3 (2.4), n=12	44.5 (4.0)	ns
BAI	18.7 (7.3)	27.7 (8.0)	.003
BDI-II	24.0 (9.9)	39.0 (8.6)	.000
CAS	12.9 (7.3)	25.9 (8.2)	.000
SF-MPQ-2	3.3 (1.5)	5.9 (1.8)	.000
PCLC	44.1 (12.8)	61.7 (9.6)	.000
PCS	24.2 (9.5)	36.1 (6.9)	.001
PDI	31.6 (14.2)	46.5 (9.4)	.002

Low and high groups of perceived injustice based on median split of IEQ scores, median = 36.5.
Significance tests were two-tailed t tests. Bonferroni adjustment $p < .006$.

Means and Standard Error on Low and High Groups of Perceived Injustice (IEQ)



Correlations among Psychological and Pain Variables

	1	2	3	4	5	6	7	8	9
1.HEAT PAIN	…	-.312	.032	-.042	-.328	-.089	-.024	-.123	-.232
2. BAI	…	…	.417*	.594**	.555**	.513**	.146	.311	.362*
3. BDI-II	…	…	…	.803**	.394*	.771**	.620**	.467**	.660**
4. CAS	…	…	…	…	.584**	.753**	.581**	.367*	.667**
5. SF-MPQ-2	…	…	…	…	…	.568**	.395*	.641**	.498**
6. PCLC	…	…	…	…	…	…	.686**	.468**	.625**
7. PCS	…	…	…	…	…	…	…	.415*	.745**
8. PDI	…	…	…	…	…	…	…	…	.524**
9. IEQ	…	…	…	…	…	…	…	…	…

* p < .05 (2-tailed). ** p < .01 (2-tailed).

All psychological and pain (measured by SF-MPQ-2) variables were significantly correlated, except anxiety which was not correlated with either pain catastrophizing or pain disability. Heat pain thresholds were not correlated with psychological and pain variables.

Regression Analysis Predictors of Self-Reported Pain Disability

	B	SE B	β
Constant	6.27	8.96	
BDI-II	0.66	0.33	.56*
CAS	-0.86	0.40	-0.61**
SF-MPQ-2	4.55	1.30	.68***

Analysis included all psychological measures concurrently. Results revealed anger and pain were significant, depression approached significance.
Model was significant, F (7, 22) = 4.39, $p < .01$
R^2 = .58.3 ($p < .01$). *p = .056, **p < .05, ***p < .01

CONCLUSIONS AND CLINICAL IMPLICATIONS

- Results suggest that individuals with higher perceived injustice seem to suffer more pain and psychological distress.
- Results also suggest that anger, pain, and depression represent risk factors for poor recovery outcomes related to disability and function.
- Further research is needed to examine whether perceived injustice is a risk factor for, or an outcome of higher levels of psychological distress, and how treatment interventions directed at reducing individuals' feelings of injustice impact on recovery and rehabilitation following motor vehicle collision trauma.
- Further research is needed to examine anger, pain, and depression as risk factors for pain disability, and how treatment interventions directed at individuals' feelings of anger and depression impact on recovery and rehabilitation following motor vehicle collision trauma.