Overview of Cognitive-Affective Factors in Musculoskeletal Practice

LOMA LINDA UNIVERSITY School of Allied Health Professions

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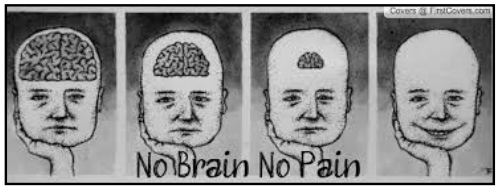
CSM 2017 SAN ANTONIO, TEXAS



Neurocognitive Pain Processing

Cognition and Pain Amplification

- High Threat Value (Appraisal)
- Fear Avoidance/Fear of Movement
- Catastrophizing/ Magnification
- Rumination/Vigilance (Attention)
- Helplessness (Self-Efficacy)

Cognitive Pain Attenuation Methods

- Cognitive Restructuring (Reappraisal/ Reconceptualization)
- Operant Conditioning
- Graded Activity/Exposure (Distraction/Attention Diversion)

Neurocognitive Pain Processing

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Pain /pān/ -

An unpleasant **sensory** and **emotional** [cognitive/affective] experience associated with actual or potential tissue damage, or described in terms of such damage.

International Association for the Study of Pain

Neurocognitive Pain Processing

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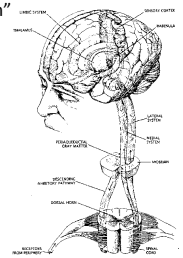
Affective/Emotional Pain ↔ Nociceptive Pain

"Medial Pain System"

Affective-Cognitive Evaluative



"Lateral Pain System"

Sensory Discriminative

Treede et al., 2008, Pain

Fear Avoidance Beliefs Questionnaire
Functional Outcomes Questionnaire: Spinal Disorders[48]
Functional Rating Index[49]
General Function Score[50]
Hannover Functional Ability Questionnaire[51]
Low Back Outcome Score[52]
Low Back Outcome Score for Back Pain[53]
Low Back Pain Rating Scale[54]
MODEMS Pain and Disability Lumbar Scale[56]
NASS Lumbar Spine Outcome Assessment Instrument[57]
Occupational Role Questionnaire[60]
Outcome Measure for Lumbar Spinal Stenosis[61,62]
Oswestry Disability Index[63]
Perception of Disability Scale[71]
Quebec Back Pain Disability Scale[72]
Roland Morris Disability Questionnaire[76]
Scoliosis Research Society 22[87]
Spinal Function Sort[92]
Spinal Pain Independence Measure[93]
Aberdeen Low Back Pain Disability Scale[94]
The Maine-Seattle Back Questionnaire[96]
Vermont Disability Prediction Questionnaire[97]
Waddell Disability Index[98]
Walter Reed Visual Assessment Scale[99]

Costa, et. al., 2007, Spine

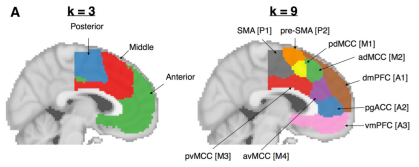
Neurocognitive Pain Processing | Cognition and Pain Amplification | Cognitive Pain Attenuation Methods

The Journal of Neuroscience, June 15, 2016 • 36(24):6553–6562 • 6553

Behavioral/Cognitive

Large-Scale Meta-Analysis of Human Medial Frontal Cortex Reveals Tripartite Functional Organization

Alejandro de la Vega,[1,2] Luke J. Chang,[3] Marie T. Banich,[1,2] Tor D. Wager,[1,3] and Tal Yarkoni[4]
[1]Department of Psychology and Neuroscience and [2]Institute of Cognitive Science, University of Colorado, Boulder, Colorado 80309, [3]Department of Psychological and Brain Sciences, Dartmouth College, Hanover, New Hampshire 03755, and [4]Department of Psychology, University of Texas, Austin, Texas



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A k = 3

Posterior - *motor function (SMA/ preSMA)*

Middle- ***pain processing, cognitive control, and affect***

Anterior
- *affect, decision making, social cognition, episodic memory*

pvMCC [M3]

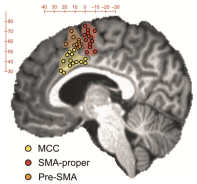
Neurocognitive Pain Processing | Cognition and Pain Amplification | Cognitive Pain Attenuation Methods

Cerebral Cortex July 2015;25:1906–1919
doi:10.1093/cercor/bhu001
Advance Access publication January 23, 2014

Neuroimaging Evidence of Motor Control and Pain Processing in the Human Midcingulate Cortex

Gaurav Misra and Stephen A. Coombes

Individual-level conjunction analysis



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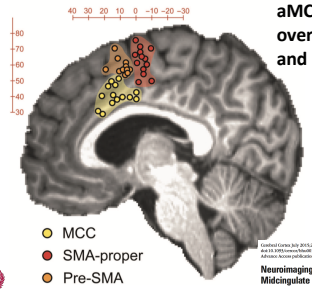
Individual-level conjunction analysis



aMCC, SMA, and preSMA overlap with motor control and pain processing

Neuroimaging Evidence of Motor Control and Pain Processing in the Human Midcingulate Cortex

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Neurocognitive Pain Processing | Cognition and Pain Amplification | Cognitive Pain Attenuation Methods

Motor Processing
(SMA/Pre-SMA)

Pain Processing
(Cognitive/Affective Processing, MCC)

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- Helplessness (Self-Efficacy)

Neurocognitive Pain Processing

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High Threat Value (Appraisal) | Fear Avoidance/Fear of Movement | Catastrophizing | Rumination (Attention) | Helplessness (Self-Efficacy)

The interpretation of an event as threatening has been shown to increase stimulus salience and to amplify the perception of pain and nonpainful stimuli

Wiech, et. al., 2010, J Neurosci

Smith, et. al., 1998, Pain

Sawamoto, et. al., 2000, J Neurosci

Severeijns, et. al., 2002, Pain

de Gier, et. al., 2003, Pain

Arntz and Claassens, 2004, Pain

Moseley and Arntz, 2007, Pain

Vlaeyen, et. al., 2009, Behave Res Ther

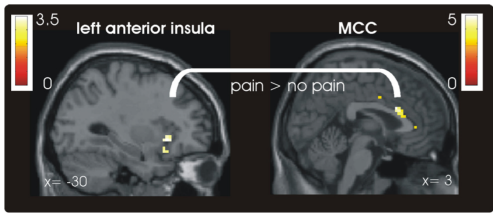
Neurocognitive Pain Processing

Cognition and Pain Amplification

Cognitive Pain Attenuation Methods

Anterior Insula Integrates Information about Salience into Perceptual Decisions about Pain

Wiech, et. al., 2010, J Neurosci



Increased functional connectivity between L Ant Insula and MCC

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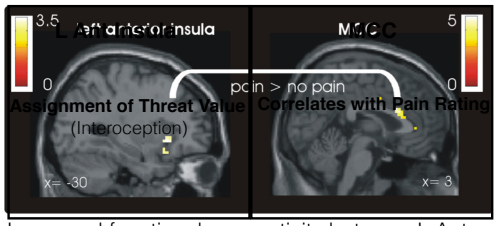
Anterior Insula Integrates Information about Salience into Perceptual Decisions about Pain

Wiech, et. al., 2010, J Neurosci



Increased functional connectivity between L Ant Insula and MCC

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Neurocognitive Pain Processing | Cognition and Pain Amplification | Cognitive Pain Attenuation Methods

High Threat Value (Appraisal) | Fear Avoidance/Fear of Movement | Catastrophizing/ Magnification | Rumination (Attention) | Helplessness (Self-Efficacy)

COGNITIVE THREAT PERCEPTION MODEL

- High Threat Value (Appraisal)
- PAIN
- Fear Avoidance/Fear of Movement
- Catastrophizing/Magnification
- Rumination (Attention)
- Helplessness vs. Self-Efficacy

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PAIN CATASTROPHIZING, FEAR-AVOIDANCE, KINESIOPHOBIA, AND LOW SELF EFFICACY have been shown to be predictive of chronic low back pain-related disability

Grotle, et. al., 2010, Pain

Picavet, et. al., 2002, Am J Epidemiol

Woby, et., al., 2004, Pain

Mannion, et., al., 2001, Spine

Wertli, et., al., 2014, Spine (Sys Rev)

Rainville, et., al., 2011, Spine J (Rev)

Gheldof, et., al., 2005, Pain

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Neurocognitive Pain Processing		Cognition and Pain Amplification		Cognitive Pain Attenuation Methods
High Threat Value (Appraisal)	Fear Avoidance/Fear of Movement	Catastrophizing/ Magnification	Rumination/Vigilance (Attention)	Helplessness (Self-Efficacy)

PAIN CATASTROPHIZING, FEAR OF MOVEMENT, PAIN VIGILANCE, AND LOW SELF EFFICACY have been shown to be predictive of chronic whiplash associated disorder pain an disability

Thompson, et. al., 2010, Physiotherapy

Andersen, et. al., 2016, Eur J Pain

Nederland, et. al., 2004, Arch Phys Med Rehabil

Buitenhuis, et., al., 2008, Spine

Bostick, et., al., 2013, Injury

Nieto, et., al., 2013, Rehabilitation Psychology

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Neurocognitive Pain Processing		Cognition and Pain Amplification		Cognitive Pain Attenuation Methods
High Threat Value (Appraisal)	Fear Avoidance/Fear of Movement	Catastrophizing/ Magnification	Rumination (Attention)	Helplessness (Self-Efficacy)

PAIN CATASTROPHIZING, FEAR AVOIDANCE, and HELPLESSNESS/LOW SELF-EFFICACY have been shown to be predictive of disability and chronic anterior knee pain, knee OA, and PFPS

Domenech, et. al., 2014, Knee Surg Sports Traumatol Arthrosc

Domenech, et. al., 2013, Knee Surg Sports Traumatol Arthrosc

Somers, et. al., 2009, J Symptom Manage

Peat, et. al., 2009, J Pain

Piva, et. al., 2009, J Rehabil Med

Pells, et., al., 2008, Pain

Marks, R., 2007, Can J Aging

Creamer, et. al., 1999

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Neurocognitive Pain Processing		Cognition and Pain Amplification		Cognitive Pain Attenuation Methods
High Threat Value (Appraisal)	Fear Avoidance/Fear of Movement	Catastrophizing/ Magnification	Rumination/Vigilance (Attention)	Helplessness (Self-Efficacy)

FEAR OF RE-INJURY and LACK OF CONFIDENCE/LOWER SELF-EFFICACY have been shown to be associated with lack of return to sport in post operative ACL reconstruction patients

Lentz, et. al., 2015, Am J Sports Med

Ardern, et. al., 2014, Br J Sports Med

Flanigan, et. al., 2013, Arthroscopy

Ardern, et. al., 2013, Am J Sports Med

Everhart, et. al., 2015,
Knee Surg Sports Traumatol Arthrosc

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Neurocognitive Pain Processing | Cognition and Pain Amplification | Cognitive Pain Attenuation Methods

Cognitive Behavioral Framework

Cognition
(Attention)

High Threat Value (Appraisal)

Rumination (attention)

Helplessness

Catastrophizing /Magnification

Fear Avoidance/Fear of Movement

Aaron T. Beck

Behavior
(coping style/action)

Emotion
(Perceived Threat)

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Neurocognitive Pain Processing | Cognition and Pain Amplification | Cognitive Pain Attenuation Methods

High Threat Value (Appraisal)	Fear Avoidance/Fear of Movement	Catastrophizing/ Magnification	Rumination/Vigilance (Attention)	Helplessness (Self-Efficacy)

High Threat Value (Appraisal) — Cognitive Decision

Fear Avoidance/Fear of Movement — Affective/Motor Response

Rumination (attention)

Helplessness

Catastrophizing/ Magnification

3 Components of Pain Catastrophizing

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High Threat Value (Appraisal)	Fear Avoidance/Fear of Movement	Catastrophizing/ Magnification	Rumination (Attention)	Helplessness (Self-Efficacy)

Pain catastrophizing

Magnification | Rumination (attention) | Helplessness

3 Components of Pain Catastrophizing

I wonder whether something serious may happen

I become afraid that the pain will get worse

I keep thinking of other painful events

I anxiously want the pain to go away

I can't seem to get it out of my mind

I keep thinking about how much it hurts

I keep thinking about how badly I want the pain to stop

I feel I can't go on

I feel I can't stand it anymore

There's nothing I can do to reduce the intensity of the pain

It's terrible and I think it's never going to get any better

I worry all the time about whether it will end

It's awful and I feel that it overwhelms me

Quartana, et. al., 2009, *Expert Rev Neurother*

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Cognitive-behavioural treatment for subacute and chronic neck pain (Review)

Monticone M, Cedraschi C, Ambrosini E, Rocca B, Fiorentini R, Restelli M, Gianola S, Ferrante S, Zanoli G, Moja L

CBT significantly better than no treatment for pain, disability, and quality of life

No differences between CBT and medication, education, physiotherapy, manual therapy, and exercise for pain/disability.

CBT moderately better than other interventions for improving fear of movement.

Monticone, et. al., 2015, The Cochrane Library

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Neurocognitive Pain Processing | Cognition and Pain Amplification | Cognitive Pain Attenuation Methods

Cognitive Restructuring (Reappraisal/Reconceptualization) | Operant Conditioning | Graded Activity/Exposure (Distraction/Attention Diversion)

Behavioural treatment for chronic low-back pain (Review)

Henschke N, Ostelo RWJG, van Tulder MW, Vlaeyen JWS, Morley S, Assendelft WJJ, Main CJ

For pain relief, there was moderate quality evidence that:

1. operant therapy was more effective than waiting list controls in the short-term,

2. there was little or no difference between operant therapy, cognitive therapy; or a combination of behavioural therapies in the short or intermediate-term, and

3. behavioural treatment was more effective than usual care (which usually consists of physical therapy, back school and/or medical treatments) in the short-term.

Henschke, et. al., 2010, The Cochrane Library

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Neurocognitive Pain Processing | Cognition and Pain Amplification | Cognitive Pain Attenuation Methods

Cognitive Restructuring (Reappraisal/Reconceptualization) | Operant Conditioning | Graded Activity/Exposure (Distraction/Attention Diversion)

WHAT IS COGNITIVE BEHAVIORAL THERAPY?

Cognitive Behavior Therapy (CBT) is a time-sensitive, structured, present-oriented psychotherapy directed toward solving current problems and teaching clients skills to ***modify dysfunctional thinking and behavior.***

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Cognitive Behavioral Framework

Cognitive Restructuring (Reappraisal/Reconceptualization)

Cognition (Attention)

I believe… my disc is herniated

Fear *Avoidance*/Fear of Movement

What I do… I avoid bending at all costs

Fear Avoidance/Fear of Movement

I feel… afraid to bend down to pick up objects from the floor

Aaron T. Beck

Behavior (coping style/action)

Emotion (Perceived Threat)

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I believe… my muscles are tight.

~~Fear Avoidance/Fear of Movement~~

What I do… I will start bending to stretch my back muscles

~~Fear Avoidance/Fear of Movement~~

I feel… comfortable with the thought of stretching my back muscles

Aaron T. Beck

Behavior (coping style/action)

Emotion (Perceived Threat)

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Cognitive Restructuring (Reappraisal/Reconceptualization) | Operant Conditioning | Graded Activity/Exposure (Distraction/Attention Diversion)

RESEARCH ARTICLE

Physiotherapy-Provided Operant Conditioning in the Management of Low Back Pain Disability: A Systematic Review†

Samantha Bunzli*, David Gillham & Adrian Esterman

University of South Australia, Australia

Summary:

Operant conditioning is more effective than back school for reducing long term disability in patients with chronic low back pain.

2. Operant conditioning may be more effective than biomedically-based physical therapy in reducing fear-avoidance.

3. Operant conditioning is more effective than placebo in reducing short-term pain in sub-acute low back pain.

Bunzli, et. al., 2011, Physiother Res Int

Neurocognitive Pain Processing | Cognition and Pain Amplification | Cognitive Pain Attenuation Methods

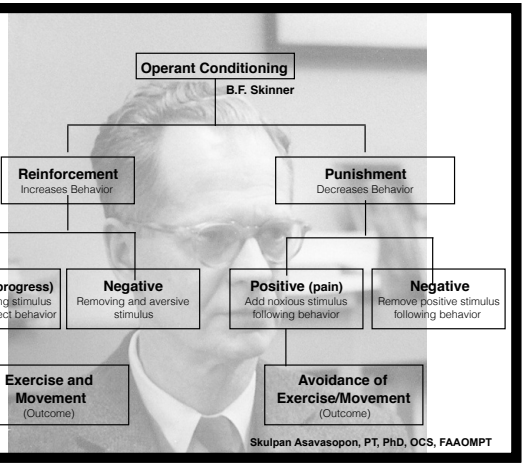
Cognitive Restructuring (Reappraisal/Reconceptualization) | Operant Conditioning | Graded Activity/Exposure (Distraction/Attention Diversion)

WHAT IS OPERANT CONDITIONING?

Type of learning in which behaviors are emitted to earn rewards or avoid punishment with the following principles:

- Goal-oriented
- Time-contingent activity management (e.g. quota-based graded exercise/activity)
- Positive reinforcement + education

Bunzli, et. al., 2011, Physiother Res Int



Neurocognitive Pain Processing | Cognition and Pain Amplification | Cognitive Pain Attenuation Methods

Cognitive Restructuring (Reappraisal/ | Operant Conditioning | Graded Activity/Exposure (Distraction/Attention

GRADED ACTIVITY FOR LOW BACK PAIN has been shown to be an effective intervention

Lindstrom, et. al., 1992, Phys Ther

Hlobil, et. al., 2005, J Occup Rehabil

Hlobil, et. al., 2007, Eur Spina J

Magalhaes, et. al., 2015, BMC Manual Therapy

Rasmussen-Barr, et. al., 2009, Spine (efficacy too)

Staal, et. al., 2008, Arthritis & Rheumatism

George, et. al., 2010, JOSPT

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Neurocognitive Pain Processing | Cognition and Pain Amplification | Cognitive Pain Attenuation Methods

Cognitive Restructuring (Reappraisal/ | Operant Conditioning | Graded Activity/Exposure (Distraction/Attention

Effect of Motor Control Exercises Versus Graded Activity in Patients With Chronic Nonspecific Low Back Pain: A Randomized Controlled Trial

Luciana Gazzi Macedo, Jane Latimer, Christopher G. Maher, Paul W. Hodges, James H. McAuley, Michael K. Nicholas, Lois Tonkin, Chris J. Stanton, Tasha R. Stanton, Ryan Stafford

Macedo, et. al., 2012, Phys Ther

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Neurocognitive Pain Processing | Cognition and Pain Amplification | Cognitive Pain Attenuation Methods

Cognitive Restructuring (Reappraisal/ | Operant Conditioning | Graded Activity/Exposure (Distraction/Attention

Principles of the Interventions	Graded Activity	Motor Control Exercise
Goal setting	✓	✓
Pain contingent		✓
Time contingent	✓	
Quotas/pacing	✓	
Reinforce wellness behavior and ignore illness behavior	✓	
Education regarding pain system and reassurance	✓	✓
Education regarding ergonomic factors and body awareness	✓	✓
Generalized (whole body) exercises with consideration of specific muscle activity		✓
Generalized (whole body) exercises without consideration of specific muscle activity	✓	

Neurocognitive Pain Processing | Cognition and Pain Amplification | Cognitive Pain Attenuation Methods

Cognitive Restructuring (Reappraisal/ | Operant Conditioning | Graded Activity/Exposure (Distraction/Attention

GRADED ACTIVITY FOR HIP AND KNEE OSTEOARTHRITIS has been shown to be an EFFECTIVE intervention

Mazzuca, SA, 2007, Nat Clin Pract Rheum

Pisters, et .al., 2010, J Physiother

Veenhof, et. al., 2006, Arthritis & Rheumatism

Veenhof, et. al., 2007, Int J Behav Med

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Neurocognitive Pain Processing | Cognition and Pain Amplification | Cognitive Pain Attenuation Methods

Cognitive Restructuring (Reappraisal/ | Operant Conditioning | Graded Activity/Exposure (Distraction/Attention

Effectiveness of Behavioral Graded Activity in Patients With Osteoarthritis of the Hip and/or Knee: A Randomized Clinical Trial

CINDY VEENHOF,[1] ALBÈRE J. A. KÖKE,[2] JOOST DEKKER,[3] ROB A. OOSTENDORP,[4] JOHANNES W. J. BIJLSMA,[5] MAURITS W. VAN TULDER,[3] AND CORNELIA H. M. VAN DEN ENDE[1]

Arthritis & Rheumatism (Arthritis Care & Research)
Vol. 55, No. 6, December 15, 2006, pp 925–934
DOI 10.1002/art.22341

ORIGINAL ARTICLE

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	Contingent way, by means of an exercise program, which is reproduced in performance charts.
	3. Integration phase: support and reinforcement of the behavioral change and integration of the increased level of activities in the daily living of the patient (maximum of 7 sessions in 5 determined booster sessions in week 18, 25, 34, 42, and 55).
Educational messages	Not pain relief, but improvement of functioning is the primary goal of the treatment. Exercise and physical activity are recommended. The performance of physical activity should not depend on the amount of pain.
Activities	Problematic activities (maximum of 3) are selected by patients on activity list. Individually tailored exercises, to improve impairments limiting the performance of these activities, are selected.
Goals	For each activity and each exercise, short-term and long-term goals are set and recorded in a treatment agreement form.
Baseline values	To determine baseline values, patients perform the selected activities until (pain) tolerance during 1 week and record these activities in a diary.
Gradually increasing exercise program	An individually based scheme is made on a time-contingent basis for each activity and exercise, starting slightly under baseline values and gradually increasing towards the preset short-term goal. Patients should neither underperform nor overperform this gradually increasing scheme.
Visual reproduction	Performance charts are used to record and visualize the performance of activities and exercises.
Reinforcement	Positive reinforcement is given towards healthy and active behavior; pain behavior is extinguished.
Stopping rule	The gradual increase of activities has to be interrupted when an active inflammatory process is suspected or diagnosed (e.g., redness of the knee, increase in knee effusion or comparable symptoms). Hereafter, the increase of activities starts at a lower level. In case of recurrent inflammatory processes, the treatment goal needs to be changed and the rate of increasing activities needs to be decelerated.
Duration	Maximum of 18 sessions within first 12 weeks. Additional booster sessions in week 18, 25, 34, 42, and 55.

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Operant Conditioning

Graded Activity/Exposure (Distraction/Attention Diversion)

Level 1 → Level "X"

Cognitive mechanisms associated with exercise:

1. Graded activity (desensitization mechanism) with quota (e.g. 1 hour/day)
2. Distraction/attention diversion mechanism
3. Positive reinforcement/reward mechanism

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Cognitive Pain Attenuation Methods

Cognitive Restructuring (Reappraisal/ Reconceptualization) → Chiropractic, Acupuncture, Physicians, Physical Therapy? → Cognitive Mechanism

Operant Conditioning / Graded Activity/Exposure (Distraction/Attention Diversion) → Physical Therapy (Biomechanical Approach) → Biomechanical Mechanism

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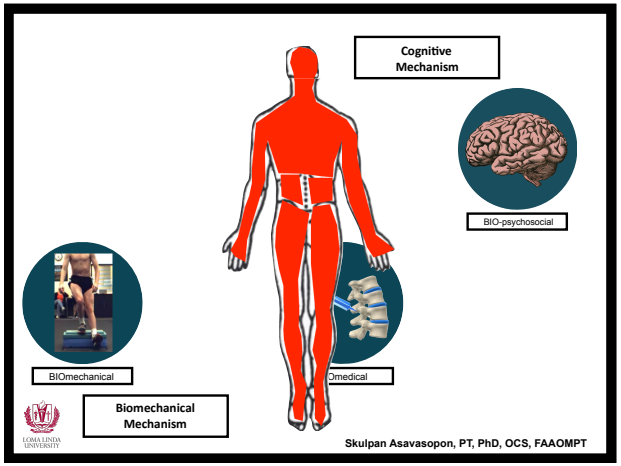
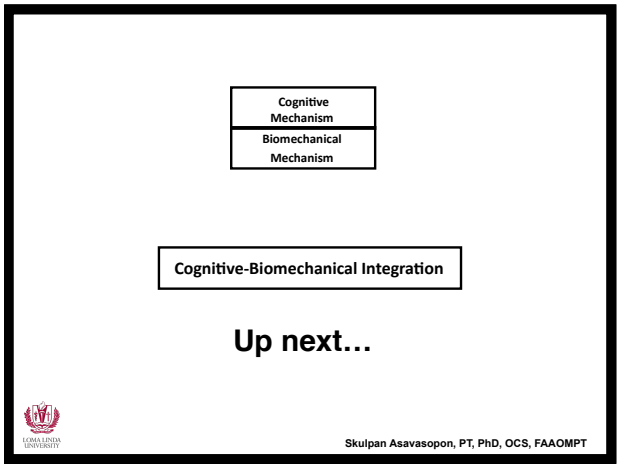

Cognitive Mechanism
BIO-psychosocial
BIOmechanical
Omedical
Biomechanical Mechanism
Skulpan Asavasopon, PT, PhD, OCS, FAAOMPT


Cognitive Mechanism
Biomechanical Mechanism
Cognitive-Biomechanical Integration
Up next…
Skulpan Asavasopon, PT, PhD, OCS, FAAOMPT

A Cognitive-Biomechanical Perspective for the Management of Common Chronic Musculoskeletal Conditions

Skulpan Asavasopon, PT, PhD
Loma Linda University

Christopher M. Powers, PT, PhD, FAPTA
University of Southern California

Session Objectives

1. Recognize common cognitive-affective attributes of patients with chronic musculoskeletal pain.
2. Understand how cognitive-behavioral methods (i.e. reappraisal) and operant conditioning (i.e. graded activity) can be integrated within a biomechanical approach to treating patients.

Session Objectives

3. Gain a new perspective and insight regarding the mechanisms underlying the cognitive modulation of pain.
4. Understand the cognitive impact of having a "story" that incorporates a physical therapy diagnosis, objective measurements, an organized exercise protocol with integrated expectations and reward mechanisms, and goals with accountability.

Session Schedule

11:00-11:10: Introduction & session overview

11:10-11:25: Overview of the biomechancial approach to musculoskeletal practice (Powers)

11:25-12:05: Overview of cognitive perspectives in musculoskeletal practice (Asavasopon)

12:05-12:45: Addressing cognitive-behavioral factors within a biomechanical framework (Both)

12:45-1:00: Questions & Answers

A bit of background…

Musculoskeletal Biomechanics Research Laboratory

Biomechanics Underlying Lower Extremity Injury

Overarching research theme:

Identification and understanding of injury mechanisms will lead to the development of more effective and efficient clinical interventions

What I have learned over the past 20 years?

- **Many if not most lower extremity injuries are the result of poor movement mechanics.**
- **Treatment and prevention of lower extremity injuries should include a biomechanical or movement perspective.**

"…Transforming Society by Optimizing Movement to Improve the Human Experience"

APTA Vision Statement
Adopted by the APTA House of Delegates
2013

Identity

- **The physical therapy profession will define and promote the "movement system" as the foundation for optimizing movement to improve the health of society...**
- **The "movement system" is the core of physical therapist practice, education, and research…**

Excerpts from the APTA Vision Statement, 2013

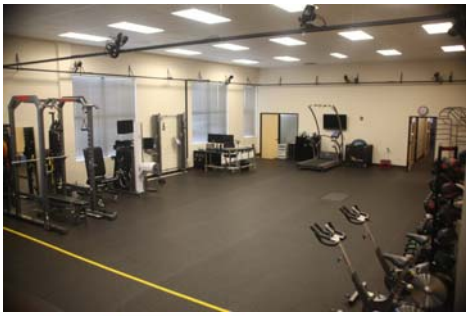
So….What is the Biomechanical Approach???

Identify "abnormal" movement patterns that may be contributory to the patient's complaint(s)

Why Evaluate Movement Clinically?

- **Most patients seek out a physical therapist care because of pain**
  - **-Typically activity or movement related**
- **Abnormal movement patterns can cause lower extremity injury & pain**
  - **-Joint stress (bone & cartilage)**
  - **-Soft tissue strain (ligament & tendon)**
  - **-Muscle overuse**

Movement Performance Institute



Patellofemoral Pain with Running

Ready to Return to Sport?

Where does Movement Analysis Fit in the Patient/Client Management Model?

- **Subjective**
  - – What is the patient's chief complaint & history?
- **What is the tissue source of pain?**
  - – Tissue provocation testing
- **Movement Examination**
  - – Are there movement impairments consistent with the patients complaints?
- **Hypothesis Driven Physical exam**
  - – What is causing the abnormal movement (decreased strength, joint motion, etc.)?

Clinical Example:

Runner with Lateral Hip Pain

Common Impairments During Running

1. Cross-over sign (Initial contact)
2. Dynamic knee valgus (Deceleration)
3. Dynamic knee varus (Deceleration)
4. Excessive hip adduction/pelvic drop (Deceleration)
5. Excessive hip internal rotation (Deceleration)
6. Excessive pelvic drop (Deceleration)
7. Excessive foot pronation (Deceleration)
8. Limited hip and/or knee flexion (Deceleration)
9. Knee forward of toe (Deceleration)
10. Vertical or extended trunk (Deceleration)
11. Lateral trunk flexion (Deceleration)
12. Limited hip extension (Toe off)
13. Excessive vertical displacement of COM (Toe off)

Common Impairments During Running

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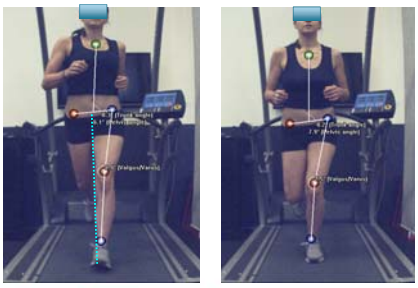
Anterior View: Deceleration



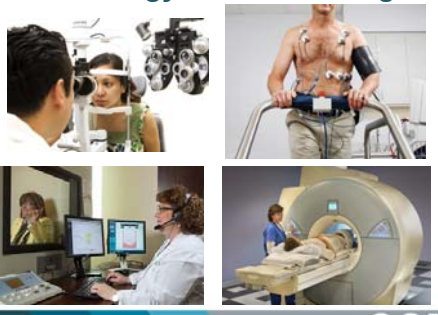
Key Clinical Exam Findings:

1. Hip Abductor weakness (32% deficit)

2. Contralateral hip flexor tightness (+30 Thomas test)

A Technology Driven Approach!

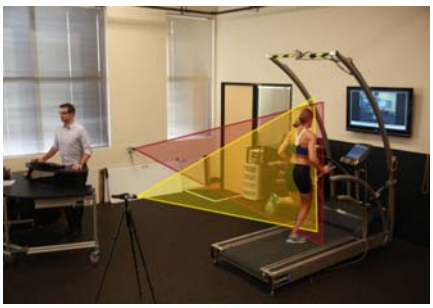
Patients Expect Healthcare Providers to Use Technology to make a Diagnosis!

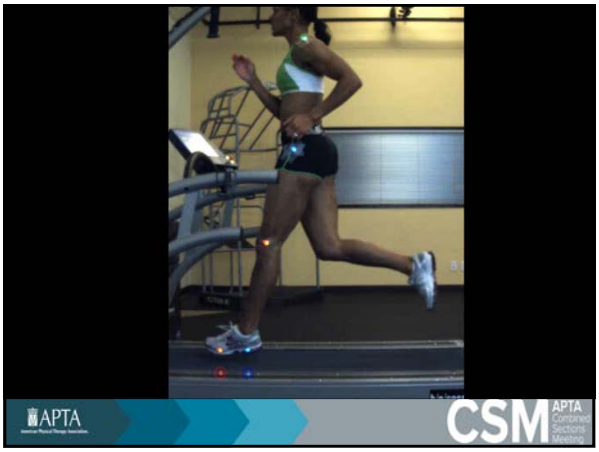


Two Basic Uses of Technology

- Diagnostics
- Treatment

Quantifying Movement Impairments





Quantifying Physical Impairments

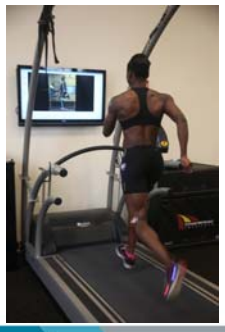
Treatment Focus:

Correct Physical Impairments

Permanent Change in Movement Behavior

Changing Movement Behavior

Visual Feedback Training



Visual Feedback Training

A Highly Structured Intervention!

Motor Learning

Coordination → Control → Skill

Muscle Performance

Activation → Strength → Movement training

Exercise Mode

Static → Dynamic → Ballistic

Knee Pain with Running:
A Biomechanical Approach

Christopher M. Powers, PT, PhD, FAPTA
University of Southern California

History & Background

- 31 year old recreational runner
  - 15 year running history
- Knee pain for 4 months
  - Insidious onset while training for marathon
  - Pain only with running
- Diagnosis of medial meniscus tear
  - Confirmed through MRI
- Referred to physical therapy, but told that surgery likely will be necessary.

History & Background

- Stopped running after Ortho consult
  - Fearful of further injury
- Expressed doubt that physical therapy would be helpful, but also expressed that he did not want surgery.
- Very anxious regarding condition and inability to run
  - Uses running for stress management

Physical Examination to Establish Tissue Source of Pain

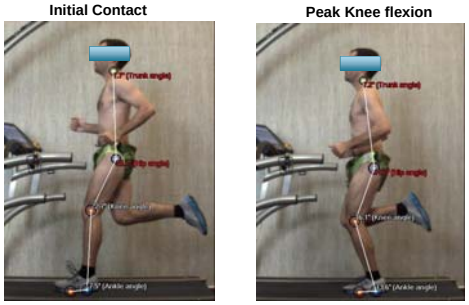
- Clinical presentation not consistent with a mensicus tear
  - Full knee range of motion
  - No swelling
  - Meniscal tests negative
  - Symptom reproduced with palpation to patellar tendon

Movement Evaluation:

Are there movement impairments consistent with the Patellar Teninopathy?

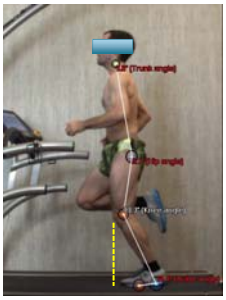
Deceleration Phase

Initial Contact | Peak Knee flexion



Movement Impairments: Limited hip flexion; Upright trunk

Late Stance



Movement Impairments: Excessive dorsiflexion (Knee forward of toe)

Key Clinical Exam Findings:

1. **Hip extensor weakness (25% deficit)**
2. **Calf weakness (50% deficit)**
   (12/25 single limb heel raises)

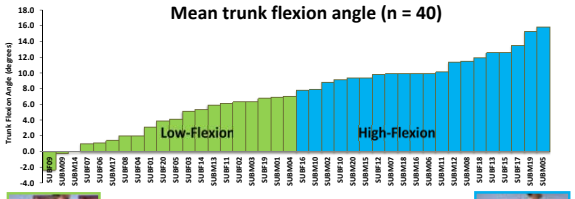
Working Hypothesis

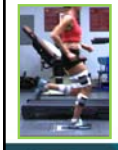
- **Running mechanics consistent with quadriceps overuse**
  - **Limited hip flexion during deceleration**
  - **Upright trunk during deceleration**
  - **Knee forward of toes in late stance**

Scientific Rationale for Hypothesis: "The Story"

Upright Trunk Posture biases the knee extensors during deceleration

High Flexion vs. Low Flexion



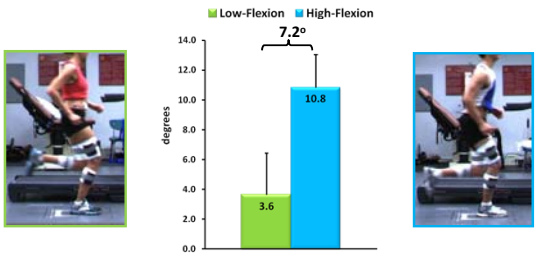


Low-Flexion:
- n = 20
- 7 men; 13 women

High-Flexion:
- n = 20
- 13 men; 7 women

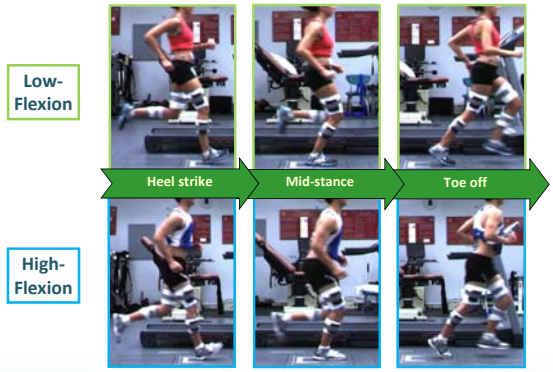
Teng & Powers, *Med Sci Sports Exerc*, 2014

High Flexion vs. Low Flexion

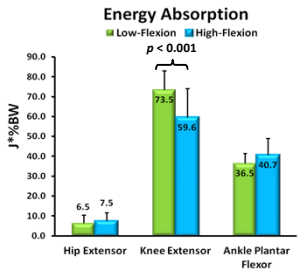


Teng & Powers, *Med Sci Sports Exerc*, 2014

High- vs. Low-Flexion

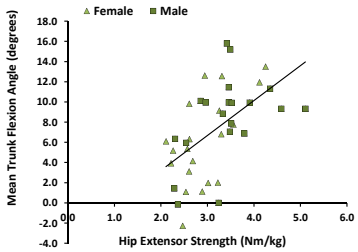


High vs. Low Trunk Flexion



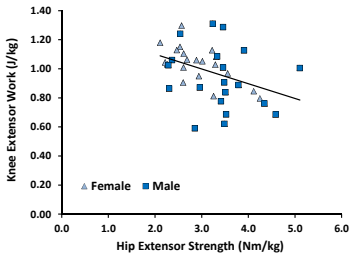
Teng & Powers, *Med Sci Sports Exerc*, 2014

Hip extensor strength is associated with trunk flexion angle during running



Teng & Powers, *J Athl Train*, 2016

Hip extensor strength is associated with knee extensor work

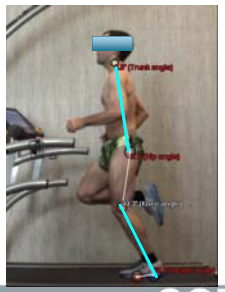


Teng & Powers, *J Athl Train*, 2016

Excessive Dorsiflexion Contributes to Quadriceps Overuse

Biscarini et al., 2011

- **Tibia > Trunk "Knee bias"**
- **Trunk > Tibia "Hip bias"**



Overarching Treatment Goal: "Story to Patient"

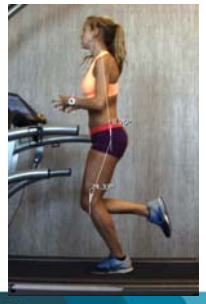
Reduce Loading on the Patellar Tendon During Running (ie. reduce reliance on quadriceps)

Treatment Plan

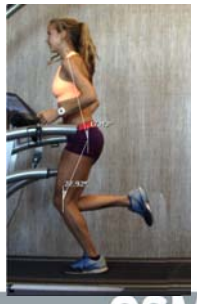
- **Improve hip extensor muscle performance**
- **Improve calf muscle performance**
- **Running re-training**
  - **Incorporate forward trunk lean**
  - **Improve hip flexion**
  - **Improve "triple extension" in late stance**

Outcome Expectations

Pre



Post



Hip Focused Return to Running Program

Level 1 (3 weeks)
Gluteal activation

↓

Level 2 (4 weeks)
Gluteal strengthening

↓

Level 3 (2 weeks)
Movement re-education (running simulation)

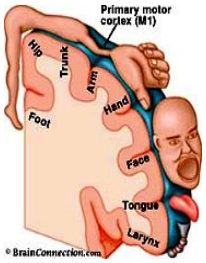
↓

Level 4
Return to running (utilizing hip strategy)

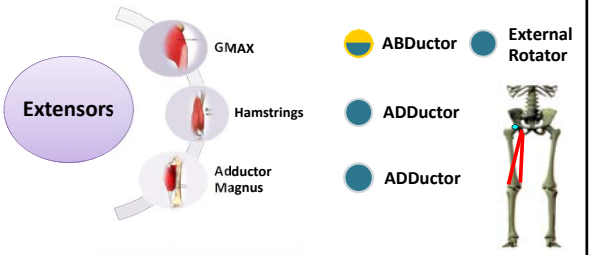
Scientific Rationale for "Activation Phase"

The Big Challenge

- **The Hip is a Redundant Muscular System: It is easy to Compensate!**
- **Gluteus Maximus is a postural muscle with poor representational area in the primary motor cortex**

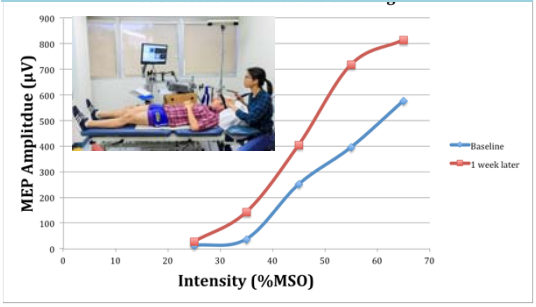


Muscular Compensations Associated With Gluteus Maximus Weakness



How do you Strengthen Gluteus Maximus if you Cannot Access (activate) it?

Increase Corticomotor Excitability Associated with Glut Max Activation Exercises



Fisher et al, *Neuro Report*, 2016

Hip Activation Exercises (Level 1)



Trunk Activation Exercises (Level 1)

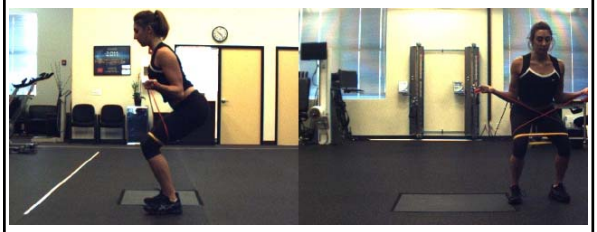



Hip Strengthening Exercises (Level 2: Double Limb)


Squat with Trunk Activation


Squat with Trunk Activation


Crab Walks with Trunk Activation



Forward Lunge (hip bias)


Hip Strengthening Exercises (Level 2: Single Limb)



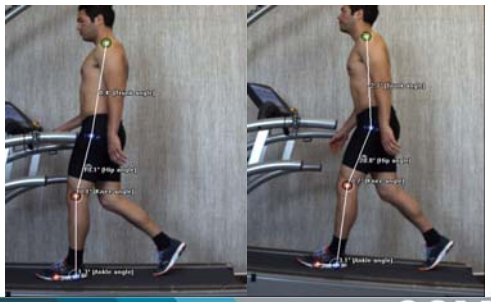
Level 3: Functional Strengthening & Movement Retraining for Running

Level 3: Functional Strengthening & Movement Retraining for Running

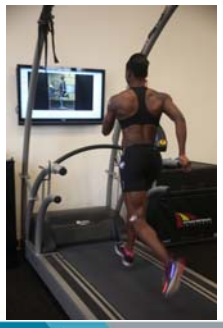
Level 3: Functional Strengthening & Movement Retraining for Running

Uphill Walking to Facilitate Hip Flexion & Forward Trunk Lean

Flat 5% incline



Return to Running Visual Feedback



Summary

- Identified the problem
- Identified a potential mechanism underlying the problem
  - Objective data
- Established a treatment strategy
  - Structured, progressive, outcome oriented
- Established measureable outcomes

Looking at a Biomechanical Approach from a Cognitive-Affective Perspective: A Case of Knee Pain with Running

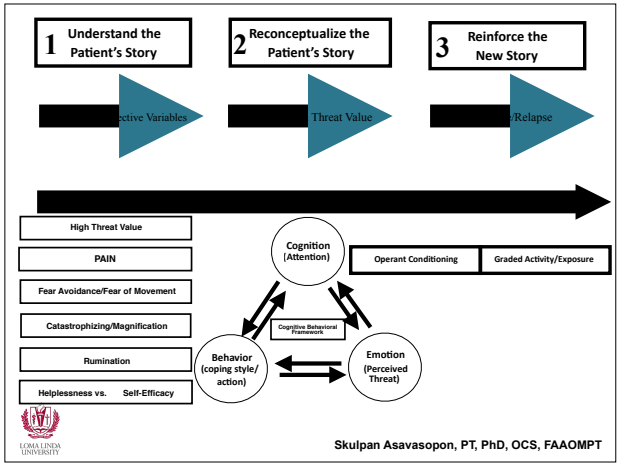
(Case from Christopher M. Powers, PT, PhD, FAPTA)

LOMA LINDA UNIVERSITY School of Allied Health Professions

Skulpan Asavasopon, PT, PhD, OCS, FAAOMPT

Assistant Professor, Loma Linda University School of Allied Health Professions, Department of Physical Therapy

Adjunct Assistant Professor of Research, USC Division of Biokinesiology and Physical Therapy



1 Understand the Patient's Story | 2 Reconceptualize the Patient's Story | 3 Reinforce the New Story

History & Background

- 31 year old recreational runner
  - 15 year running history
- Knee pain for 4 months
  - Insidious onset while training for marathon
  - Pain only with running
- Diagnosis of medial meniscus tear
  - Confirmed through MRI
- Referred to physical therapy, but told that surgery likely will be necessary.

Cognitive Appraisal?

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1 Understand the Patient's Story | 2 Reconceptualize the Patient's Story | 3 Reinforce the New Story

History & Background

- Stopped running after Ortho consult
  - Fearful of further injury
- Expressed doubt that physical therapy would be helpful, but also expressed that he did not want surgery.
- Very anxious regarding condition and inability to run
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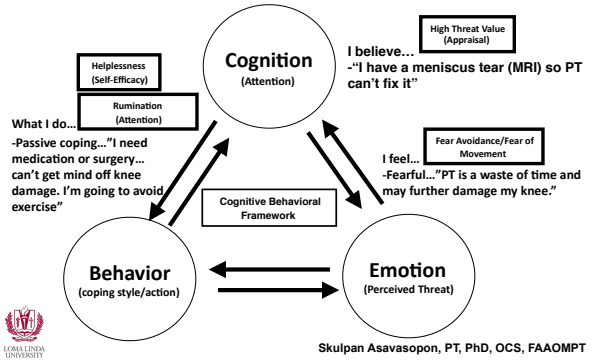
Cognitive Appraisal?

1 Understand the Patient's Story | 2 Reconceptualize the Patient's Story | 3 Reinforce the New Story



Skulpan Asavasopon, PT, PhD, OCS, FAAOMPT

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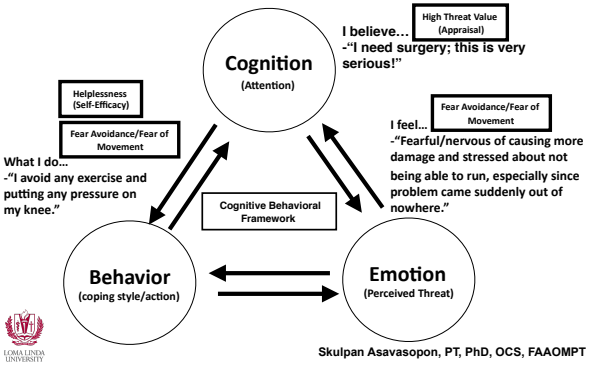

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1 Understand the Patient's Story | 2 Reconceptualize the Patient's Story | 3 Reinforce the New Story

Provide
"The Biomechanical Story:"

Reduce Loading on the Patellar Tendon During Running
(e.g. reduce reliance on quadriceps)

1 Understand the Patient's Story | 2 Reconceptualize the Patient's Story | 3 Reinforce the New Story

Physical Examination

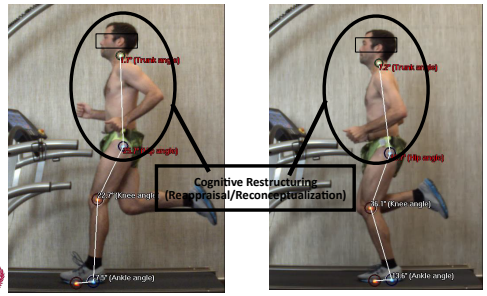
- Clinical <u>presentation not consistent with a mensicus tear</u>
  - Full knee range of motion
  - No swelling
  - Meniscal tests negative
  - Symptom reproduced with palpation to patellar tendon

Cognitive Restructuring (Reappraisal/Reconceptualization)

Skulpan Asavasopon, PT, PhD, OCS, FAAOMPT

1 Understand the Patient's Story | 2 Reconceptualize the Patient's Story | 3 Reinforce the New Story

Upright Trunk Posture biases the knee extensors during deceleration

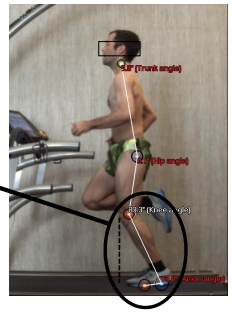


Cognitive Restructuring (Reappraisal/Reconceptualization)

Skulpan Asavasopon, PT, PhD, OCS, FAAOMPT

1 Understand the Patient's Story | 2 Reconceptualize the Patient's Story | 3 Reinforce the New Story

Excessive dorsiflexion biases the knee extensors during acceleration



Cognitive Restructuring (Reappraisal/Reconceptualization)

Tibia vs. Trunk Angulation
Biscarini et al., 2011

1 Understand the Patient's Story | 2 Reconceptualize the Patient's Story | 3 Reinforce the New Story

Key Strength Exam Findings:

1. Hip extensor weakness (25% deficit)
2. Calf weakness (50% deficit)

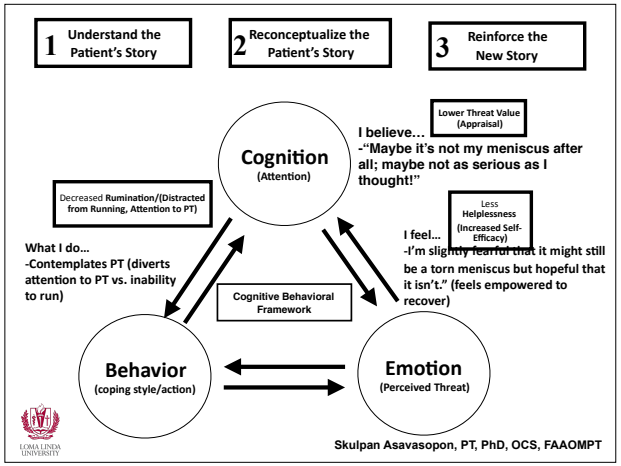
Cognitive Restructuring (Reappraisal/Reconceptualization)

1 Understand the Patient's Story | 2 Reconceptualize the Patient's Story | 3 Reinforce the New Story

Outcome Expectations

Pre Post

Cognitive Restructuring (Reappraisal/Reconceptualization)


1 Understand the Patient's Story
2 Reconceptualize the Patient's Story
3 Reinforce the New Story
Cognition
(Attention)
Lower Threat Value (Appraisal)
I believe…
-"Maybe it's not my meniscus after all; maybe not as serious as I thought!"
Decreased Rumination/(Distracted from Running, Attention to PT)
Less Helplessness (Increased Self-Efficacy)
I feel…
-I'm slightly fearful that it might still be a torn meniscus but hopeful that it isn't." (feels empowered to recover)
What I do…
-Contemplates PT (diverts attention to PT vs. inability to run)
Cognitive Behavioral Framework
Behavior
(coping style/action)
Emotion
(Perceived Threat)
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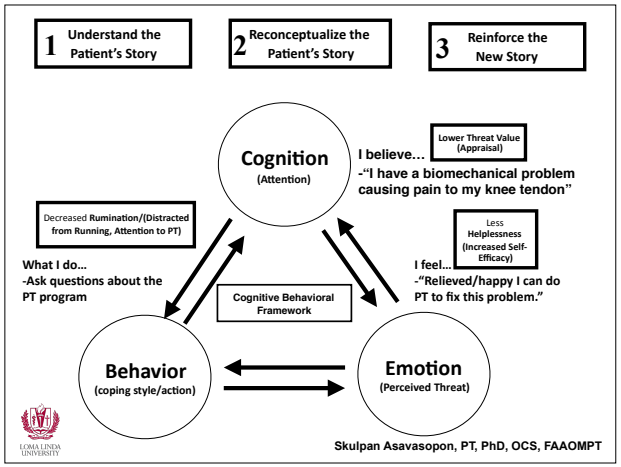
1 Understand the Patient's Story
2 Reconceptualize the Patient's Story
3 Reinforce the New Story
Cognition
(Attention)
Lower Threat Value (Appraisal)
I believe…
-"I have a biomechanical problem causing pain to my knee tendon"
Decreased Rumination/(Distracted from Running, Attention to PT)
Less Helplessness (Increased Self-Efficacy)
I feel…
-"Relieved/happy I can do PT to fix this problem."
What I do…
-Ask questions about the PT program
Cognitive Behavioral Framework
Behavior
(coping style/action)
Emotion
(Perceived Threat)
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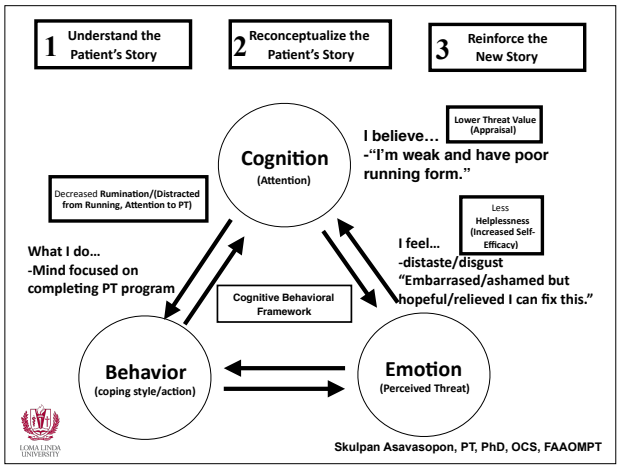
Skulpan Asavasopon, PT, PhD, OCS, FAAOMPT


1 Understand the Patient's Story
2 Reconceptualize the Patient's Story
3 Reinforce the New Story
Cognition
(Attention)
Lower Threat Value (Appraisal)
I believe…
-"I'm weak and have poor running form."
Decreased Rumination/(Distracted from Running, Attention to PT)
Less Helplessness (Increased Self-Efficacy)
I feel…
-distaste/disgust
"Embarrased/ashamed but hopeful/relieved I can fix this."
What I do…
-Mind focused on completing PT program
Cognitive Behavioral Framework
Behavior
(coping style/action)
Emotion
(Perceived Threat)
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Education Checklist

What is the diagnosis?

How serious is this condition/prognosis?

How long will this take to get better?

Will it resolve completely?

Why/how did this happen?

What do you have to offer?

What do I need to do or not do for this condition?

What are my options?

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Treatment Plan

- **Improve hip extensor muscle performance**
- **Improve calf muscle performance**
- **Running re-training**
  - **Incorporate forward trunk lean**
  - **Improve hip flexion**
  - **Improve "triple extension" in late stance**

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Operant Conditioning	Graded Activity/Exposure (Distraction/Attention)

Level 1 (3 weeks)
Gluteal activation & flexibility

⇩

Level 2 (4 weeks)
Gluteal strengthening & flexibility

⇩

Level 3 (2 weeks)
Movement re-education (running simulation)

⇩

Level 4
Return to running (utilizing hip strategy)

- **Distraction away from running/attention toward hip program**
- **Positive reinforcement/reward mechanism**
- **Quota-based: 1 hr/day without worsening of pain**
- **Attention on normalizing movement, not pain**

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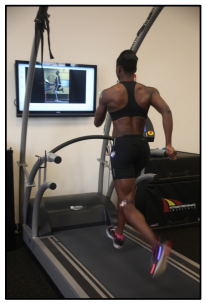
Operant Conditioning | Graded Activity/Exposure (Distraction/Attention)

- Distraction [illegible] running/att[illegible] toward hip p[illegible]
- Positi[illegible] reinf[illegible]t/reward me[illegible]
- C[illegible]sed: 1 hr/day [illegible]t worsening of [illegible]
- Attention on normalizing movement, not pain



Return to Running Visual Feedback

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[illegible]ective Variables → Threat Value → [illegible]/Relapse

1 Understand Symptom Behavior | 2 Normalize Relevant Biomechanical Variables | 3 Implement New Movement Strategy

[illegible]ical Nature → [illegible]Tissue Stress(es) → [illegible]e/Relapse

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THANK YOU

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