

MILD TRAUMATIC BRAIN INJURY & POST-CONCUSSIVE SYMPTOMS

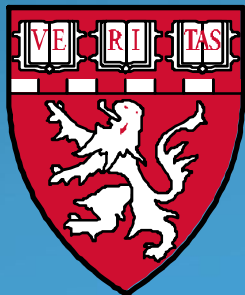
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Work Related Injuries Workshop
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DISCLOSURES

- My wife has a psychotherapy private practice.

DEFINITION: MILD TBI (CONCUSSION)

- External force with perturbation of brain
 - Loss of memory for before or after trauma
 - Or, < 30” LOC *or* other mental status change (including being ‘dazed’) *or* other neurologic sequelae
 - And, after 30”: GCS score 13-15
 - And, PTA <24 hrs

(mTBI Committee, HI-ISIG, ACRM, 1993)

*If intracranial findings on day of injury CT, then “complicated mild”

(Williams, 1990)

MOST COMMON POST-CONCUSSIVE SYMPTOMS

- Headaches
- Dizziness
- Fatigue or sleepiness
- Forgetfulness
- Inattention
- Slow processing
- Irritability
- Insomnia
- Depression
- Anxiety
- Nausea & vomiting
- Sensitivity to light & noise

PERSISTENT POST-CONCUSSIVE SYMPTOMS

- Continue >3 months
- Sports concussions: 1-3% have PPCS
- Concussions of all etiologies: <5% up to 31% > controls
(Mickieviciene, 2004; Ontario Neurotrauma Foundation, 2010;
Iverson, Silverberg et al. In Zasler, Katz, Zafonte, 2013)



CONTROVERSY OVER LONG-TERM COGNITIVE IMPAIRMENT & PCS AFTER MILD TBI

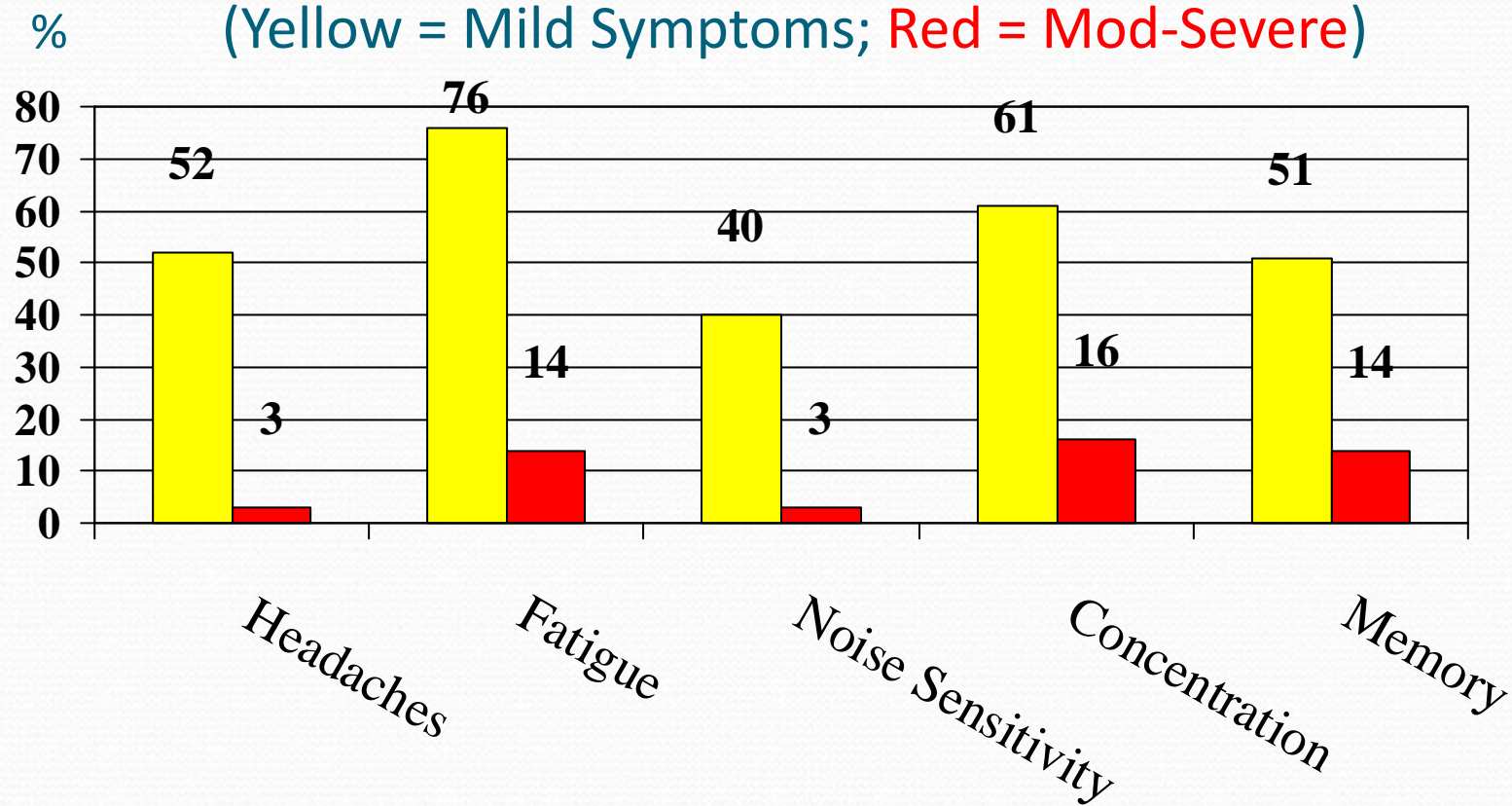
The black & white perspective:

1: It's all in their heads.

OR

2: It's caused by brain injury.

PCS-LIKE SYMPTOMS IN COMMUNITY CONTROLS (Yellow = Mild Symptoms; Red = Mod-Severe)



PCS-LIKE SYMPTOMS IN COMMUNITY CONTROLS

DSM-IV diagnosis of postconcussion disorder 79.6%

Moderate-severe symptom endorsement 14.6%

POST-CONCUSSIVE SYMPTOMS 3-4 MONTHS POST-IRAQ DEPLOYMENT

	w LOC	w MS Δ	Other injury	No injury
Headache	32%	18%	12%	8%
Dizziness	8%	6%	3%	2%
Fatigue	53%	40%	35%	20%
Sleep Problem	54%	45%	37%	24%
Memory	25%	16%	14%	7%
Concentration	31%	26%	18%	10%

(Hoge et al, 2008)

OTHER CONDITIONS WITH “POST-CONCUSSIVE SYMPTOMS”

- Common in
 - Depression & anxiety, including PTSD & acute stress
 - Whiplash injuries
 - Fibromyalgia
 - Non-head injuries
 - People litigating non-head injuries
 - General population



NON-BRAIN INJURY CAUSES OF SPECIFIC POST-CONCUSSIVE SYMPTOMS

- Headache: neck pain, soft tissue injury, occipital neuralgia, vascular changes (migraine), difficulty concentrating, insomnia, sleep apnea, psychological stresses, medications, etc.
- Dizziness: vestibular injury, neck pain, psychological stresses, medications, etc.
- Insomnia: anxiety, depression, sleep disorders, medications, etc.

CAUSES OF COGNITIVE IMPAIRMENT & FATIGUE

- Brain injury
- Insomnia
- Pain, e.g., headache
- Stress, depression, & anxiety (including PTSD)
(Diaz-Ferreira et al, 2009)
- Medications
- Vicious cycle can develop with above!

(Continued next slide)

CAUSES OF COGNITIVE IMPAIRMENT & FATIGUE

- Sleep apnea & other sleep disorders
- Aging
- Neuroendocrine disorders
 - Incidence 16.8% in mTBI (Schneider et al., 2007; Tanriverdi et al., 2010)
- Other medical illness
- ADHD & learning disability
- Expectation (“diagnosis threat”) (Suhr & Gunstad, 2002; 2005)
- Misattribution
- Secondary gain (spectrum: somatoform disorders to malingering)

- NP testing usually cannot distinguish brain injury from other causes

Typical Course of Mild TBI

SPORTS CONCUSSIONS

- Many studies test before & after
- Recovery to pre-injury cognition within days or weeks
- Most studies done with young subjects

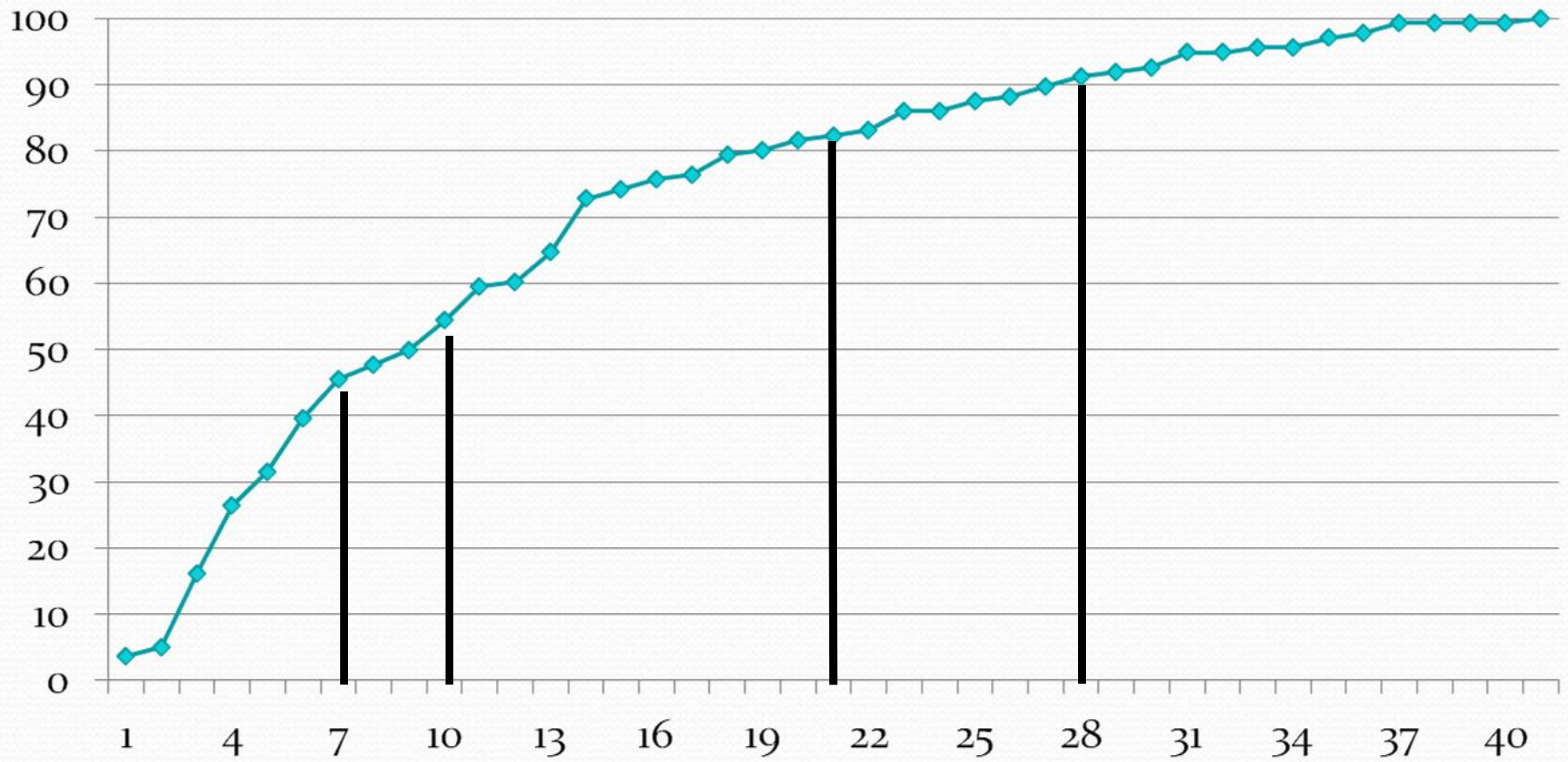
(E.G., McCrea et al. 2003; Pellman et al, 2006; Collins et al, 2006; Dikmen et al,1995)

PENNSYLVANIA HIGH SCHOOL FOOTBALL PLAYERS

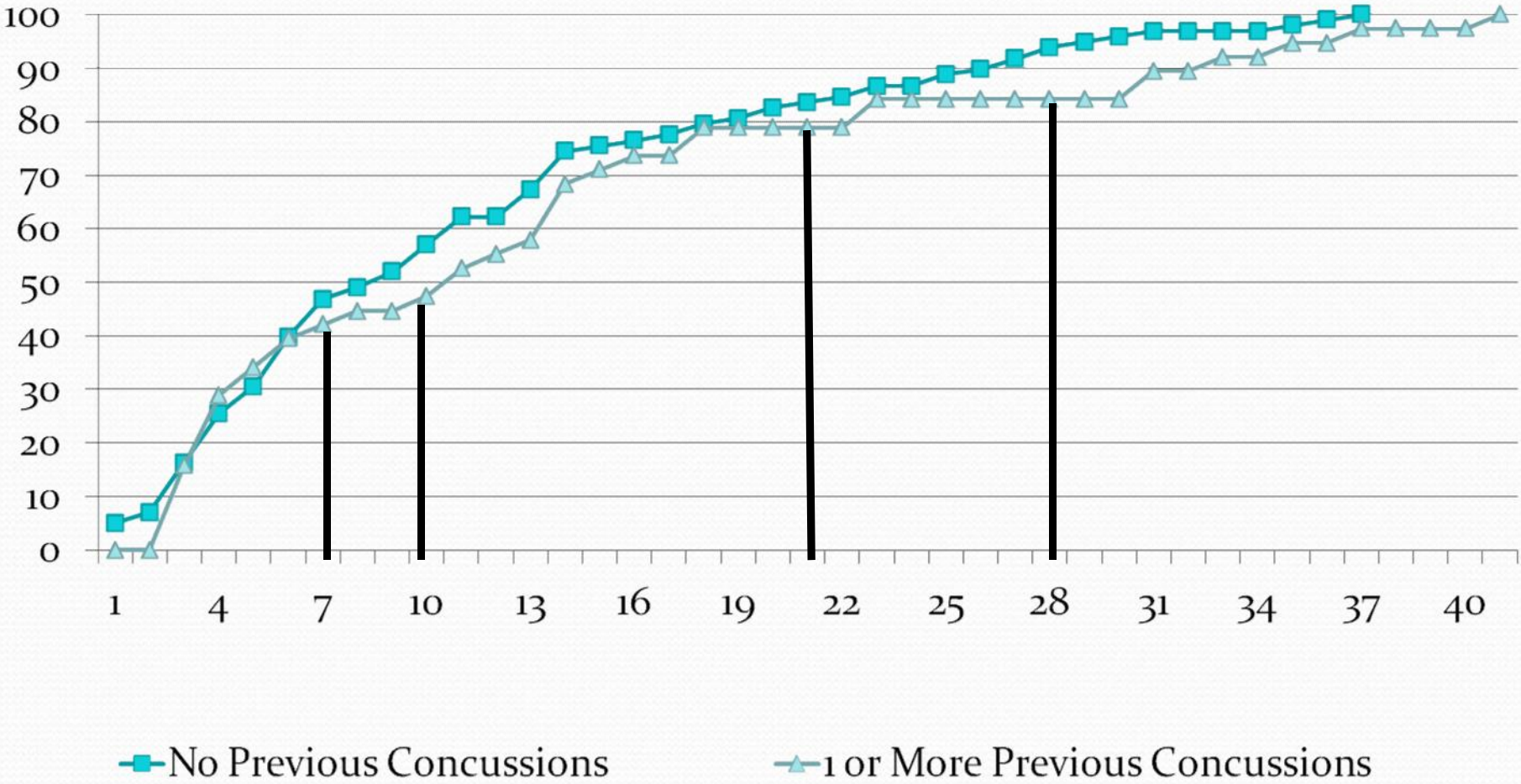
- 2,141 players
- 134 concussions
- Players tested until recovered

(Collins et al 2006)

RECOVERY CURVE (N = 134)



RECOVERY CURVES (N = 134)



META-ANALYSIS

- Cognitive recovery from mild TBI is complete within 3 months*
(Schretlan DJ, et al, 2003; Rohling et al, 2011)

*Studies of people with “complicated mild” TBI show differences from controls & other mTBI (Williams, 1990; Kashluba et al, 2008)

PREDICTORS OF PCS AFTER MILD TBI

- 2 Groups
 - Mild TBI
 - Orthopedic injuries
- Predictors of PCS at 3 months post
 - pre-injury psychiatric history
 - pre-injury physical health
 - Having had mTBI and cognitive test scores did not predict PCS

(Ponsford et al, 2012)

COGNITIVE IMPAIRMENT: SYMPTOM AUGMENTATION (EXAGGERATION)

- Forensic Military Population:
 - 59% of mTBI failed effort testing
 - Testing worse than severe TBI associated with failure of effort testing
(Lange et al, 2012; Rohlings et al, 2010; Larson, 2013)
- Civilian Worker's Compensation Population:
 - 26.7% of mTBI failed Test of Memory Malingering (TOMM)
 - Higher rate in those with better compensation
 - Moderate-severe TBI had similar rates
 - *So failure does not exclude impairment related to TBI*
(Bianchini et al, 2006)
- Malingering: Difficult to be certain unless effort testing is positive
 - But the presence of malingering does not R/O TBI as part of cause

INDICATORS THAT POSSIBLE NON-BRAIN INJURY FACTORS ARE INVOLVED

- Persistence of symptoms in those with mildest injuries (e.g., “dazed”) or no concussion
- Worse than severe TBI on testing
- Testing not compatible with level of function
- Little or no improvement in cognitive status over time



HOWEVER, THERE IS ANOTHER SIDE TO THE STORY

THOSE WITH PERSISTENT BRAIN DYSFUNCTION MAY BE OUTLIERS

- Small # impaired can be obscured in studies & meta-analyses
- Larger studies needed (many 1,000's)

(Iverson, 2010; Glenn, 2014)

NON-PSYCHOSOCIAL PREDICTORS OF PCS

- Predictors of PCS at 3 mos after mTBI & “complicated” mTBI
 - pre-injury psychiatric history
 - age
 - lower education
- Predictors of PCS at 6 mos after mTBI & “complicated” mTBI
 - Above plus GCS score, injury caused by assault, & extracranial injury

(Lingsma et al, 2014)

AGE & MTBI

- Association of lasting cognitive impairment with older age (Mazzucci et al, 1992; Papa et al, 2012; Lingsma et al, 2014)
- Some studies show no such association (Goldstein et al, 2001; Mickeviciene et al, 2004; Yuh et al, 2014)

SUBTLE CHANGES AFTER MILD TBI

- Differences on more difficult cognitive tests at ≥ 3 mos compared to controls (Bleiburg et al, 1998; Vanderploeg et al, 2005; Malojcic, 2008; Pare et al, 2009)
- Balance & gait impaired during cognitive tasks years after mTBI (Broglia, 2012)

SPORTS: LONG-TERM RESIDUA OF MULTIPLE CONCUSSIONS

- NP testing worse than controls
 - Suggests at least subclinical residua
 - $0 + 0 + 0 = 0$
 - $1 + 1 + 1 = 3$
- NP testing worse with multiple concussions & h/o learning disability
- However baseline testing not obtained: those with more impairment pre-injury may have more concussions

(Roberts, 1975; Collins et al, 1999; Matser et al, 1999; Guskiewicz et al, 2005 Iverson et al, 2006; Belanger et al, 2010; Lehman, 2012)

CHRONIC TRAUMATIC ENCEPHALOPATHY

- 85 boxers, football & hockey players, & military veterans with multiple concussions*
 - Most had cognitive impairment or dementia
 - Some had Parkinsonian features
 - Some had depression, suicidality, aggression
 - 68 had pathologic findings of CTE (see next slide)
 - 43 CTE alone
 - Others with MND, AD, FTD, Lewy body disease
 - Symptoms usually began 8-10 years after retired
 - 1 asymptomatic, 2 dx'd with PTSD only

(Mckee et al, 2009, 2012)

*+1 person with repetitive head-banging

PATHOLOGY

- Chronic traumatic encephalopathy
 - Cerebral atrophy
 - Tau immunoreactive inclusions
 - Neurofibrillary tangles
 - Glial tangles
 - Neuropil neurites
 - Different distribution than in AD
 - Some cases: beta-amyloid
 - Some cases: TDP-43 proteinopathy
 - Cavum septi pellucidi with fenestrations
 - Shrinkage of the mammillary body

(McKee et al, 2009; McKee et al, 2012; Gavett et al, 2011)

CHRONIC TRAUMATIC ENCEPHALOPATHY

- Mckee et al studies
 - Not population based, so we do not know incidence
 - Few controls (e.g., perhaps many asymptomatic players have these findings)
 - No baseline assessment

EVIDENCE FROM BIOMARKERS SUGGESTIVE OF LONG-STANDING BRAIN INJURY

- MRI: Diffusion tensor imaging (DTI) (Inglese et al, 2005; Kraus et al, 2007; Lipton et al, 2009; Shenton et al, 2012; Lipton et al, 2012; Lange et al, 2012; Koerte et al, 2012)
- Functional MRI (fMRI) (McAllister et al, 2006; Mayer, 2011)
- Event-related potentials (Lachapelle et al, 2008; Broglio, 2012)
- Magnetic resonance spectroscopy (MRS)
- Single positron emission CT (SPECT)
- Positron emission tomography (PET)
- Magnetic source imaging (MEG + MRI)
- Serum protein S-100B (Stalnacke et al, 2005; Shahim et al, 2014)

ETIOLOGY OF LONG-TERM COGNITIVE RESIDUA OF MTBI?

MY OPINION: THERE IS A SPECTRUM

1. Persistent significant brain injury: More extensive mTBI than is typical
 2. Persistent brain injury, often minor, with one or more of the following:
 - Prior concussion(s)
 - Numerous subconcussive blows
 - Previous learning disability
 - APOE ϵ -4 genotype
 - Older age
 - Pre-injury psychological susceptibility
 - Anxiety &/or depression (pre-existing or related to PCS-see later slide)
- (Continued next slide)

ETIOLOGY OF LONG-TERM COGNITIVE RESIDUA OF MTBI?

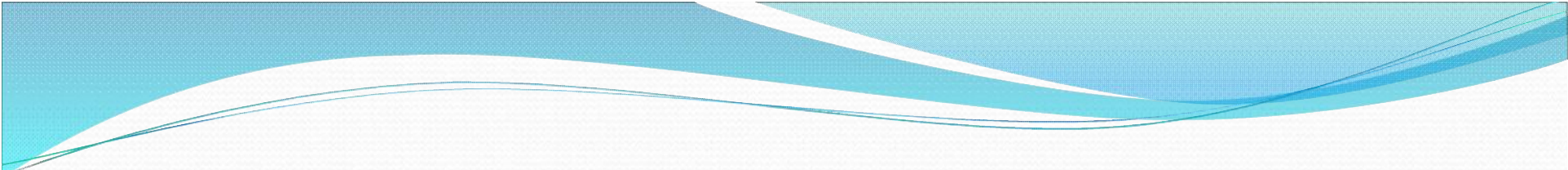
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- PTSD related to circumstances surrounding injury
 - Stressful social-vocational circumstances
 - Sleep disorders: insomnia, sleep apnea, others
 - Chronic headaches or other pain
 - Secondary financial gain
3. Impairment due to TBI resolved, but 1 or more of above factors persist
 4. Never actually had a TBI, but has one or more of above

EVIDENCE FOR MULTIFACTORIAL ETIOLOGY OF PCS

- Regression analyses: predictors of worse 6-month RPQ-13 scores after mTBI
 - age ($p=.02$)
 - trend for neuropsychiatric history ($p=0.07$)
 - trend for axonal disruption in at least one area on DTI at 3 weeks ($p=.07$)
(Yuh et al, 2014)

The best approach to mTBI is a “complex biopsychosocial model”.
(Iverson)



IT CAN BE EXTREMELY STRESSFUL
TO HAVE A MILD TBI WITH
COGNITIVE &/OR PHYSICAL SYMPTOMS

TOTAL IMPAIRMENT

PAIN, INSOMNIA

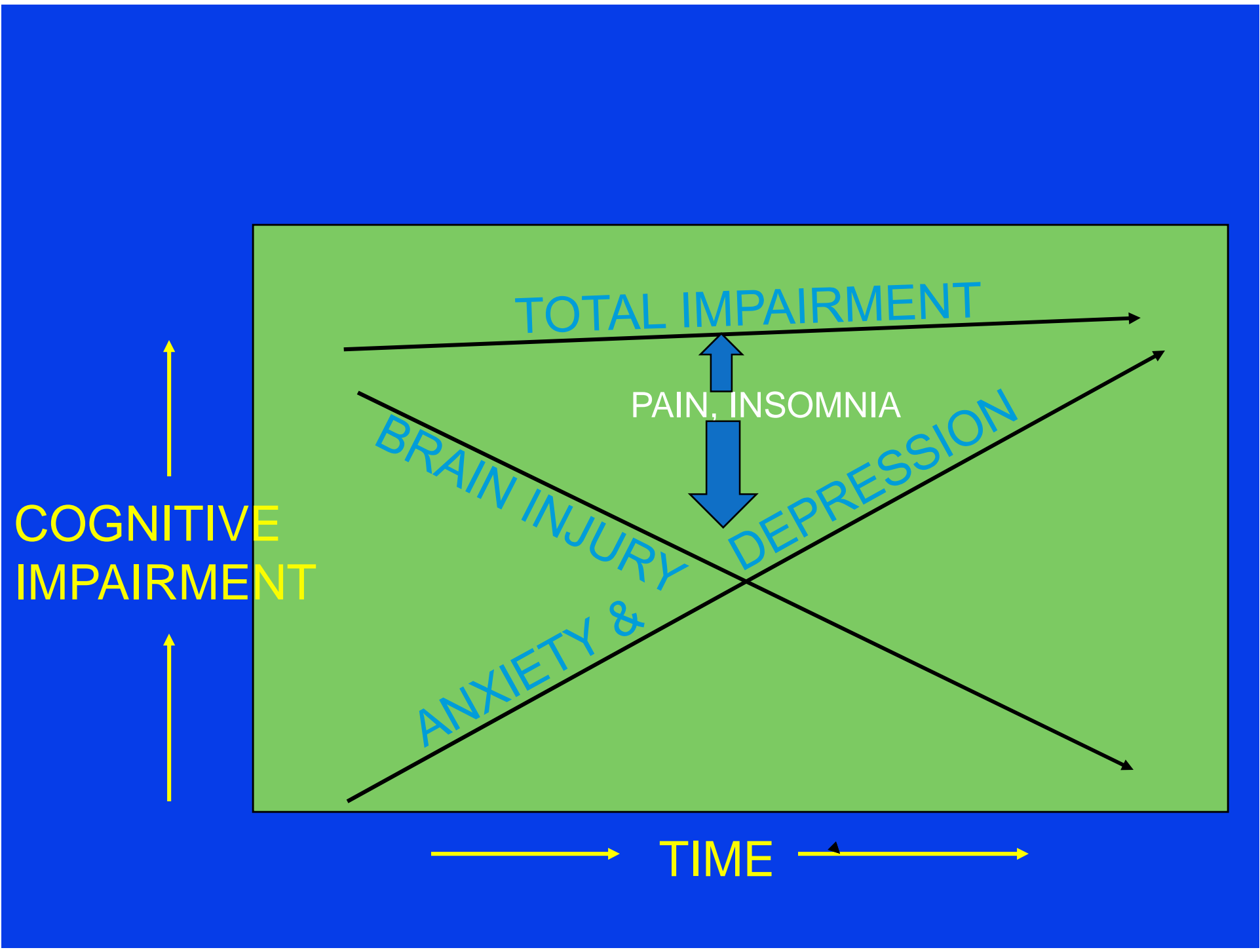
BRAIN INJURY

DEPRESSION

ANXIETY &

COGNITIVE IMPAIRMENT

TIME



POST-CONCUSSION SYMPTOMS: MANAGEMENT

- Early

- No return to sports, school, or work that day
- Out of sports, school, or work until symptom-free or reduced
- No driving for at least 24 hours, longer depending on symptoms
- Take it easy (short walks, visiting with friends, TV) for “a while”
 - Children with shorter rest time took longer to recover

(Brown et al, 2014)

- Gradual return to activity; graded exercise for athletes
- Educate, reassure within reason
- Validate stress & anxiety
- Explain & anticipate-stress can worsen symptoms

(Harmon et al, 2013; Silverberg & Iverson, 2013; Ontario Neurotrauma Foundation, 2010; McRory, 2009)

POST-CONCUSSION SYMPTOMS: MANAGEMENT

- Late: treat symptomatically
 - “Easier” to treat & underlying symptoms 1st (e.g., OSA, endocrine, insomnia, depression)
 - Cognitive later (OT, Speech Therapy)
 - Rehabilitation: Emphasize endurance, attention, processing speed
 - Medications (Chew & Zafonte, 2009)
 - Psychotherapy usually indicated: See next slide

(Ontario Neurotrauma Foundation, 2010)

PSYCHOLOGICAL SYMPTOMS: TREATMENT

- **Psychotherapy**
 - Cognitive behavior therapy: targets thought process, reframing
 - Acceptance and commitment therapy (ACT): targets acceptance, mindfulness, values
 - Self-management: targets self-efficacy, acceptance
(Iverson et al, Ch. 30 in Zasler, Katz, Zafonte, 2013)
 - Eye movement desensitization and reprocessing (for PTSD)
 - Exposure therapy (for PTSD)
- **Medications for depression & anxiety**
 - Start with SSRI's in most cases
 - Prazosin for post-traumatic nightmares (Berardis et al, 2015)
(Ontario Neurotrauma Foundation, 2010)

POST-CONCUSSION SYMPTOMS: MANAGEMENT

- Late: Global treatment approaches
 - Global treatments
 - Exercise below heart rate causing symptoms (Leddy et al, 2010)
 - Self-management therapy
 - Have patient set functional goals (e.g., I will have dinner with my family 3x/week)
 - Return next week to discuss progress and barriers
- (Iverson, Personal Communication, 2014)

POST-CONCUSSION SYMPTOMS: MANAGEMENT

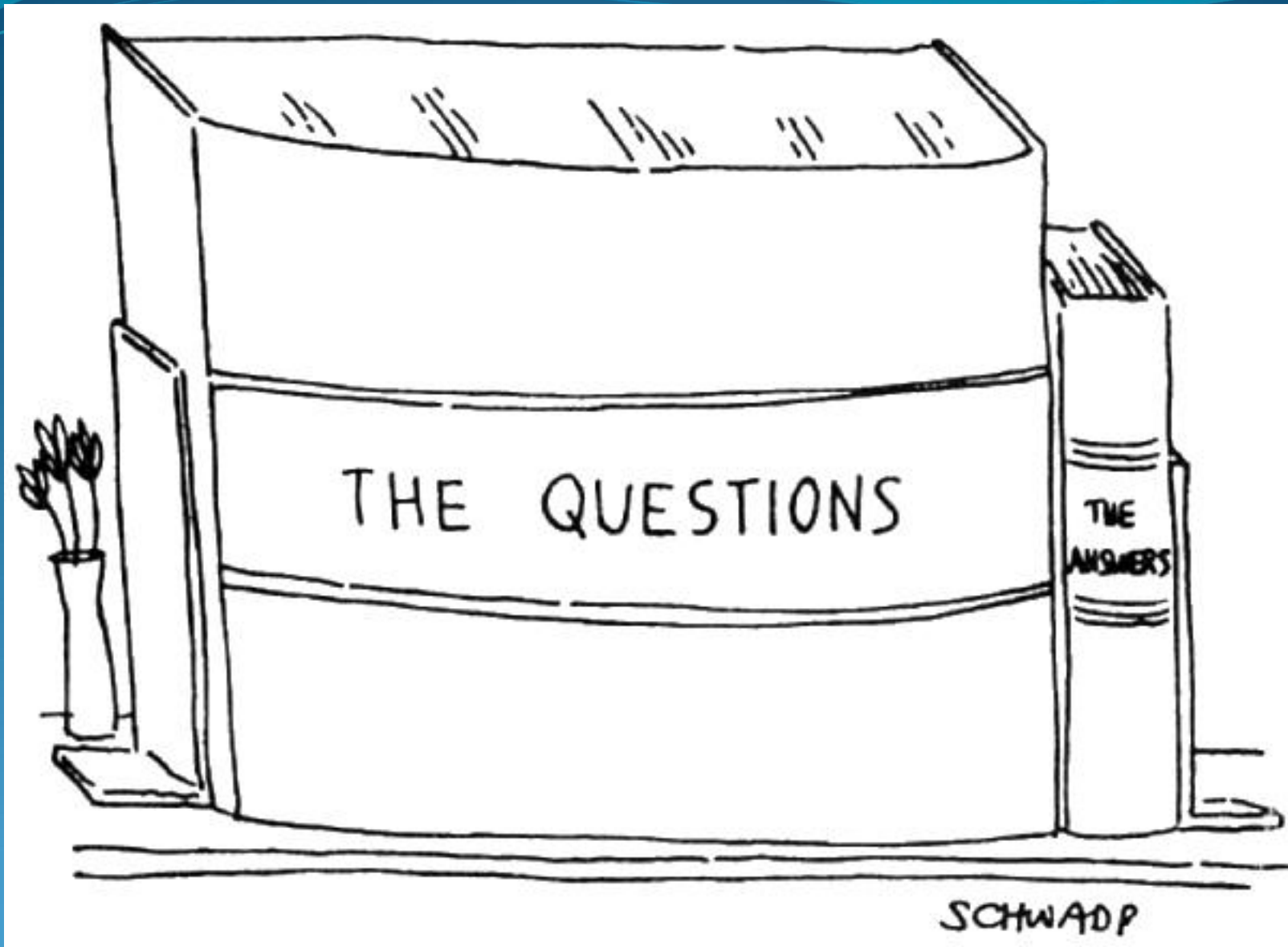
- Alternative Medicine Treatments
 - Acupuncture, Acupressure (Mcfadden et al, 2011)
 - Emotional Freedom Techniques (“tapping”) (Gilomen & Lee, 2015)
 - Homeopathy (Chapman et al, 1999)
 - Mindfulness Meditation (Johansson et al, 2012)
 - Integrative Restoration Yoga Nidra (Stankovic, 2011; Pence et al, 2014)

SUMMARY

- mTBI may leave persistent PCS in some
- Approach as a “complex biopsychosocial” phenomenon
- Other factors may contribute to persistent cognitive impairment
 - Previous concussions
 - Learning disability or ADD
 - Psychological factors
 - Social/vocational factors
 - Pain
 - Sleep disorders
 - Age
 - Secondary gain
- Treatment of PCS
 - Education
 - Treat symptomatically
 - Psychotherapy: CBT, ACT, self-management, supportive/insight
 - Aerobic exercise



THANK YOU!



*Work Related Injuries Workshop
June 2015*