Speaker Disclosure

Grand Rounds – July 22, 2015

Mental Health in Pediatric Concussions: Foundational principles in the multidisciplinary approach to care

Jonathan Romain, PhD & Sharief Taraman, MD

Faculty Disclosure - *The speakers have no relevant financial relationships to disclose in the last 12 months with a commercial interest that manufactures products or provides services that will be discussed in today's CME Activity.*

Financial Disclosure – *No commercial support was received for this activity.*

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CHOC Children's

Gaps in Knowledge / Practice:

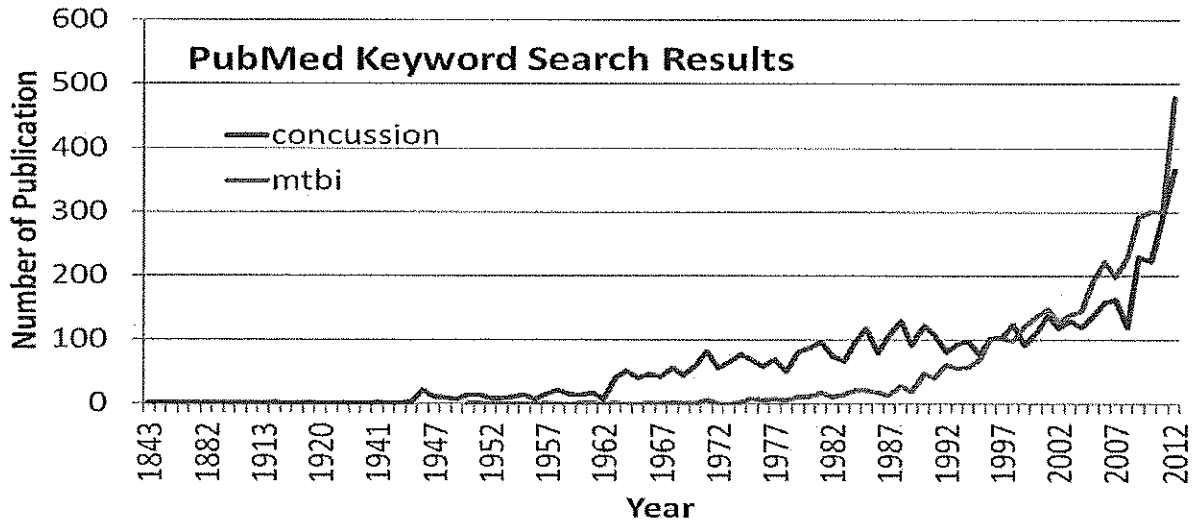
- In 2012, Children's Hospital of Philadelphia funded a survey of primary care and emergency medicine providers. Some of the 145 respondents **did not recognize important concussion symptoms**, including eye tracking (17%), difficulty concentrating (11%), vestibular disturbance (9%), drop off in school performance (6%), and sensitivity to light or sound (6%). Similarly, in a study published in the Journal of Neuroscience Nursing, fewer than 25% of nurses expressed high knowledge level in the skills needed for the identification and assessment of mTBI patients, and less than 15% had high knowledge in the treatment and prognosis of these patients.

- Despite growing awareness of sports-related concussions and campaigns to educate athletes, coaches, physicians, other healthcare providers and parents of young athletes about concussion recognition and management, **confusion and controversy persist in many areas**. The IOM and the National Research Council formed an expert committee to review the science of sports-related concussions in youth from elementary school through young adulthood, as well as in military personnel and their dependents. The findings were published in October 2013.

Objectives

- Understand how to assess the cognitive and psychological impact of concussions in their patients.
- Counsel patient and families on effective cognitive and psychological health recovery after a concussion.
- Advise when and how to appropriately reintegrate students to return to school and/or sports activities.
- Determine when to refer to a specialist for further evaluation.
- Identify health disparities among socioeconomic subgroups in the care and management of concussions.

Information Overload!



An estimated 1.7 million TBIs occur in the United States annually.

(CDC, 2010)

AAP Clinical Report 2010

- A clear definition of concussion requires consensus among researchers, clinicians, and patients, each of whom require a different construct for understanding the injury.
- Some advocate using the term "concussion," and others advocate using the term "mild traumatic brain injury" (mTBI).
- Injury described as a concussion is perceived as less severe than one described as mild traumatic brain injury, which may result in a premature return to school and activity.

Zurich 2012

Concussion is a brain injury and is defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces. Several common features that incorporate clinical, pathologic and biomechanical injury constructs that may be utilised in defining the nature of a concussive head injury include:

1. Concussion may be caused either by a direct blow to the head, face, neck or elsewhere on the body with an "impulsive' force transmitted to the head.
2. Concussion typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously. However, in some cases, symptoms and signs may evolve over a number of minutes to hours.
3. Concussion may result in neuropathological changes, but the acute clinical symptoms largely reflect a functional disturbance rather than a structural injury and, as such, no abnormality is seen on standard structural neuroimaging studies.
4. Concussion results in a graded set of clinical symptoms that may or may not involve loss of consciousness. Resolution of the clinical and cognitive symptoms typically follows a sequential course. However, it is important to note that in some cases symptoms may be prolonged.

The majority (80–90%) of concussions resolve in a short (7–10 day) period, although the recovery time frame may be longer in children and adolescents.

AAN Practice Parameter 2013

Concussion is recognized as a clinical syndrome of biomechanically induced alteration of brain function, typically affecting memory and orientation, which may involve loss of consciousness.

Random House Dictionary

con·cus·sion [kuh'n-**kuhsh**-uh'n] Show IPA

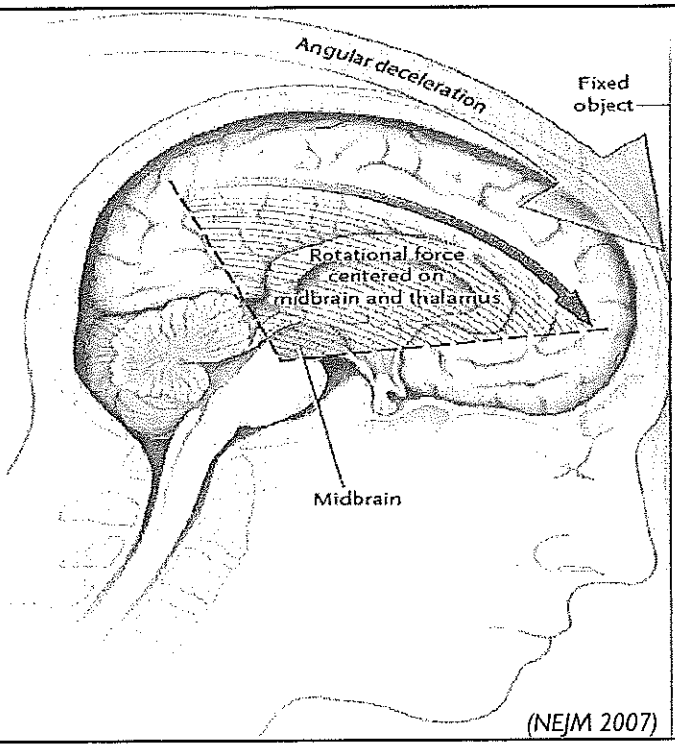
noun

1. *Pathology* . injury to the brain or spinal cord due to jarring from a blow, fall, or the like.
2. shock caused by the impact of a collision, blow, etc.
3. the act of violently shaking or jarring.

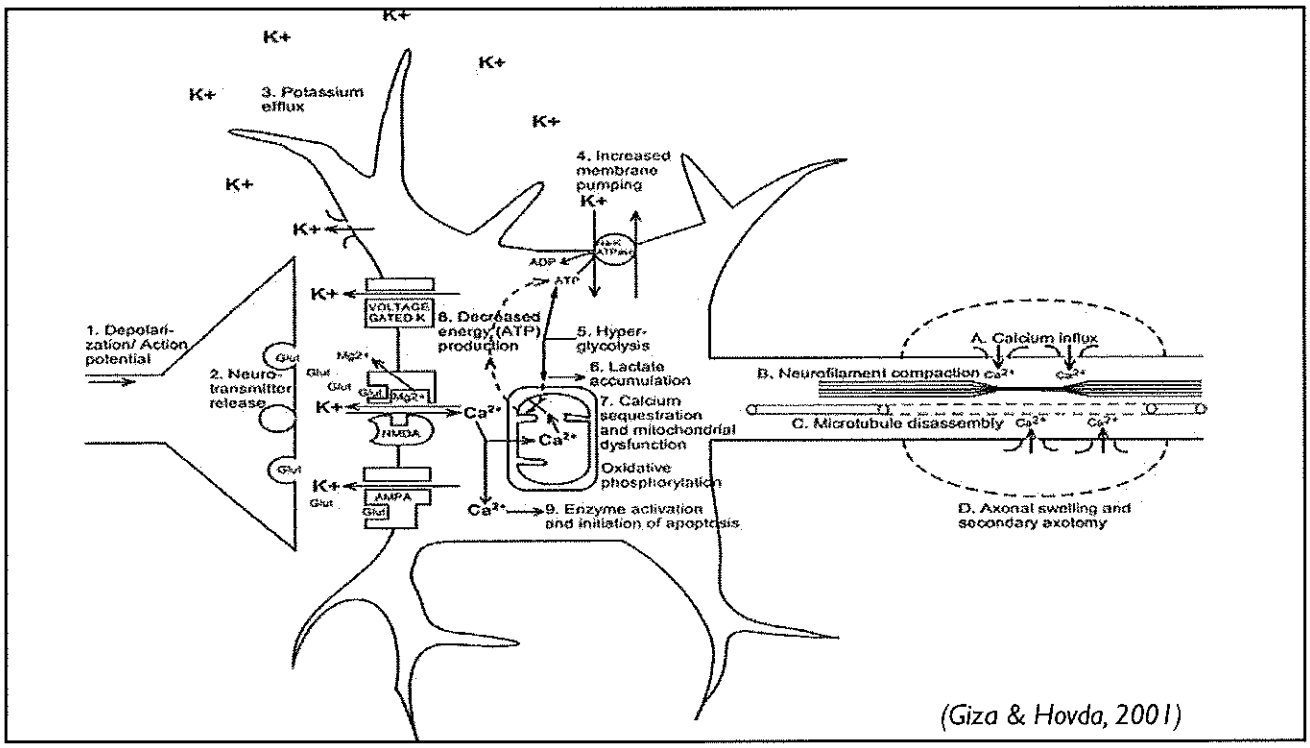
Origin:

1350–1400; Middle English < Latin *concussiōn-* (stem of *concussiō*) a shaking. See concuss, -ion

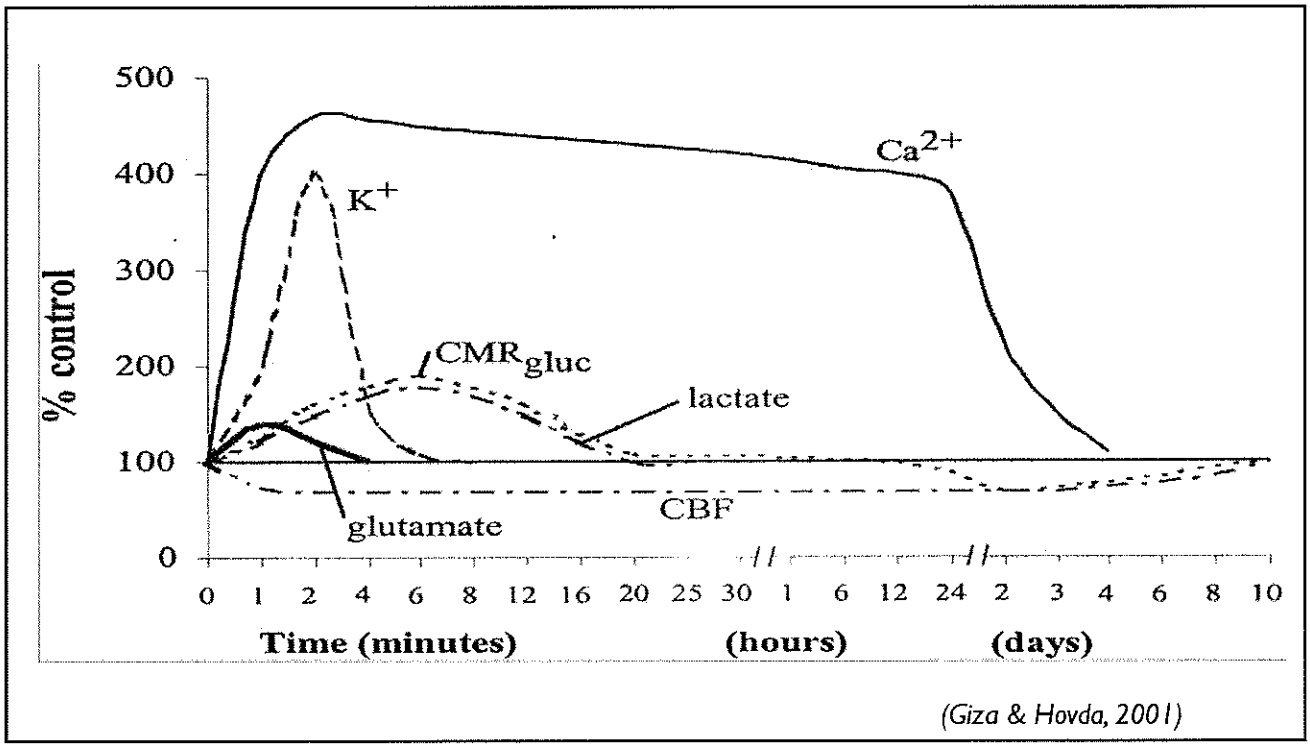
- Injury caused by rotational motion of the cerebral hemispheres in the anterior–posterior plane, around the fulcrum of the fixed in-place upper brain stem
- Alteration of consciousness likely due to disruption of the electrophysiological and subcellular activities of the neurons of the reticular activating system that are situated in the midbrain and diencephalic region, where the maximal rotational forces are exerted



(NEJM 2007)



(Giza & Hovda, 2001)



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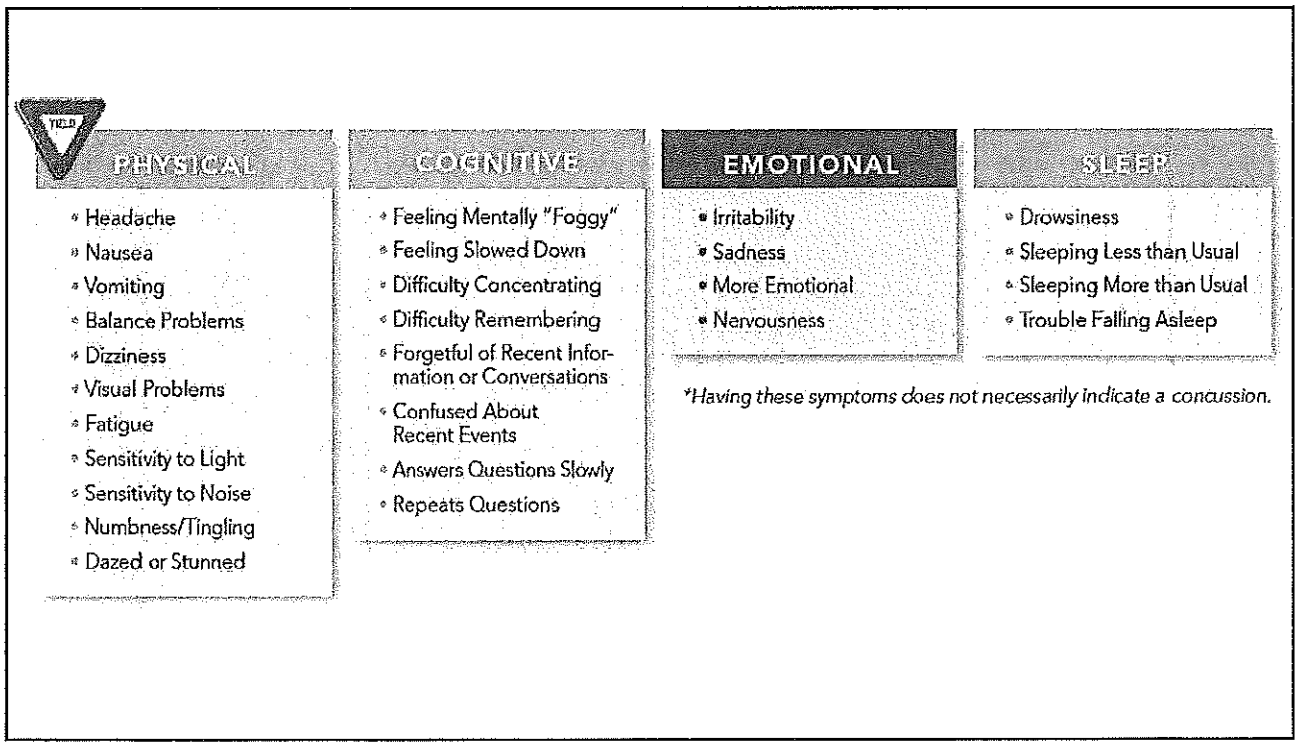
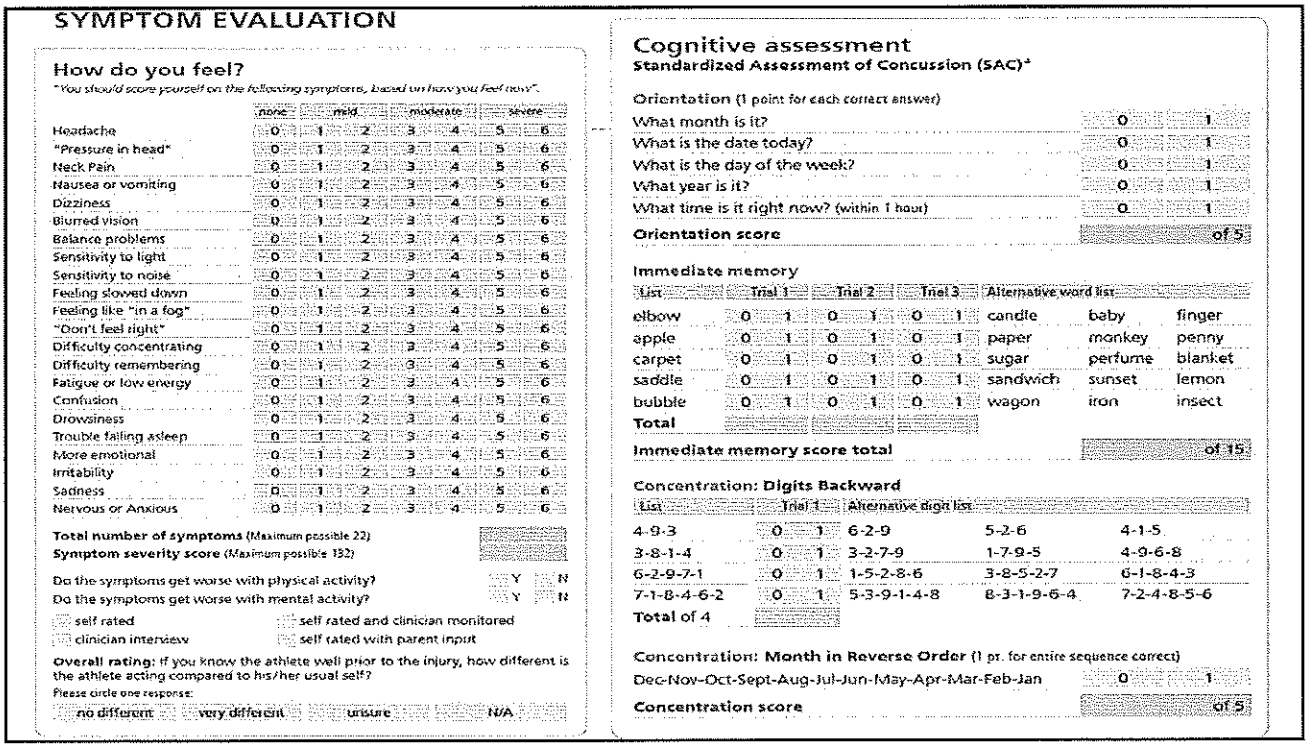


The Cognitive Effects of mTBI

- Cognitive issues immediately following concussion are common.
- Neuropsychological deficits can be seen in the time frame defined as Post Concussive Syndrome (loosely symptom persistence for 10 days to 3 months).
- It becomes more difficult to use neuropsychological tests to track cognitive recovery in Persistent Postconcussive Syndrome (symptoms extending beyond 3 months).

Symptom resolution should trump cognitive assessment in PCS.



SYMPTOM EVALUATION

How do you feel?

"You should score yourself on the following symptoms, based on how you feel now".

	none	mild		moderate			severe
Headache	0	1	2	3	4	5	6
"Pressure in head"	0	1	2	3	4	5	6
Neck Pain	0	1	2	3	4	5	6
Nausea or vomiting	0	1	2	3	4	5	6
Dizziness	0	1	2	3	4	5	6
Blurred vision	0	1	2	3	4	5	6
Balance problems	0	1	2	3	4	5	6
Sensitivity to light	0	1	2	3	4	5	6
Sensitivity to noise	0	1	2	3	4	5	6
Feeling slowed down	0	1	2	3	4	5	6
Feeling like "in a fog"	0	1	2	3	4	5	6
"Don't feel right"	0	1	2	3	4	5	6
Difficulty concentrating	0	1	2	3	4	5	6
Difficulty remembering	0	1	2	3	4	5	6
Fatigue or low energy	0	1	2	3	4	5	6
Confusion	0	1	2	3	4	5	6
Drowsiness	0	1	2	3	4	5	6
Trouble falling asleep	0	1	2	3	4	5	6
More emotional	0	1	2	3	4	5	6
Irritability	0	1	2	3	4	5	6
Sadness	0	1	2	3	4	5	6
Nervous or Anxious	0	1	2	3	4	5	6

Total number of symptoms (Maximum possible 22)

Symptom severity score (Maximum possible 132)

Do the symptoms get worse with physical activity? Y N

Do the symptoms get worse with mental activity? Y N

self rated | self rated and clinician monitored

clinician interview | self rated with parent input

Overall rating: If you know the athlete well prior to the injury, how different is the athlete acting compared to his/her usual self?

Please circle one response:

no different | very different | unsure | N/A

Cognitive assessment

Standardized Assessment of Concussion (SAC)[4]

Orientation (1 point for each correct answer)

What month is it?	0	1
What is the date today?	0	1
What is the day of the week?	0	1
What year is it?	0	1
What time is it right now? (within 1 hour)	0	1
Orientation score		of 5

Immediate memory

List	Trial 1		Trial 2		Trial 3		Alternative word list		
elbow	0	1	0	1	0	1	candle	baby	finger
apple	0	1	0	1	0	1	paper	monkey	penny
carpet	0	1	0	1	0	1	sugar	perfume	blanket
saddle	0	1	0	1	0	1	sandwich	sunset	lemon
bubble	0	1	0	1	0	1	wagon	iron	insect
Total									

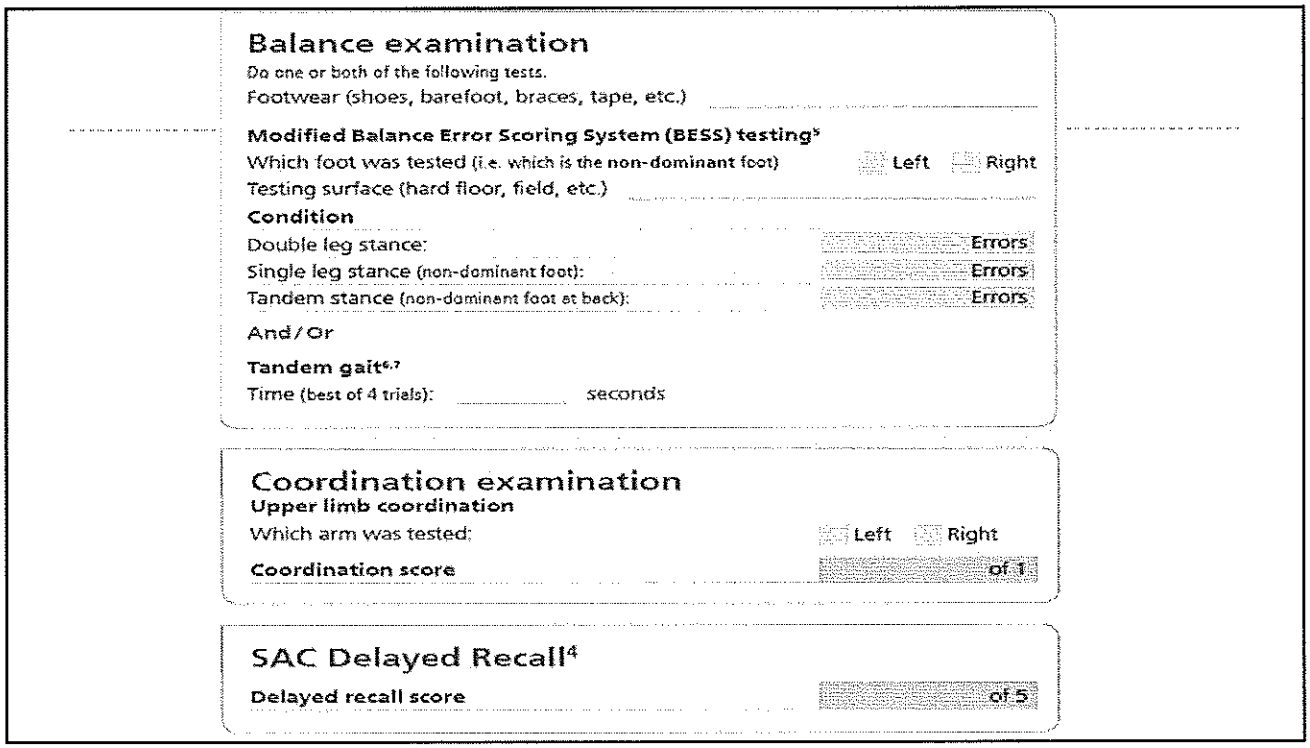
Immediate memory score total of 15

Concentration: Digits Backward

List	Trial 1		Alternative digit list		
4-9-3	0	1	6-2-9	5-2-6	4-1-5
3-8-1-4	0	1	3-2-7-9	1-7-9-5	4-9-6-8
6-2-9-7-1	0	1	1-5-2-8-6	3-8-5-2-7	6-1-8-4-3
7-1-8-4-6-2	0	1	5-3-9-1-4-8	8-3-1-9-6-4	7-2-4-8-5-6
Total of 4					

Concentration: Month in Reverse Order (1 pt. for entire sequence correct)

Dec-Nov-Oct-Sept-Aug-Jul-Jun-May-Apr-Mar-Feb-Jan	0	1
Concentration score		of 5



Balance examination

Do one or both of the following tests.

Footwear (shoes, barefoot, braces, tape, etc.)

Modified Balance Error Scoring System (BESS) testing[5]

Which foot was tested (i.e. which is the **non-dominant** foot) Left Right

Testing surface (hard floor, field, etc.)

Condition

Double leg stance: Errors

Single leg stance (non-dominant foot): Errors

Tandem stance (non-dominant foot at back): Errors

And / Or

Tandem gait[6,7]

Time (best of 4 trials): seconds

Coordination examination

Upper limb coordination

Which arm was tested: Left Right

Coordination score of 1

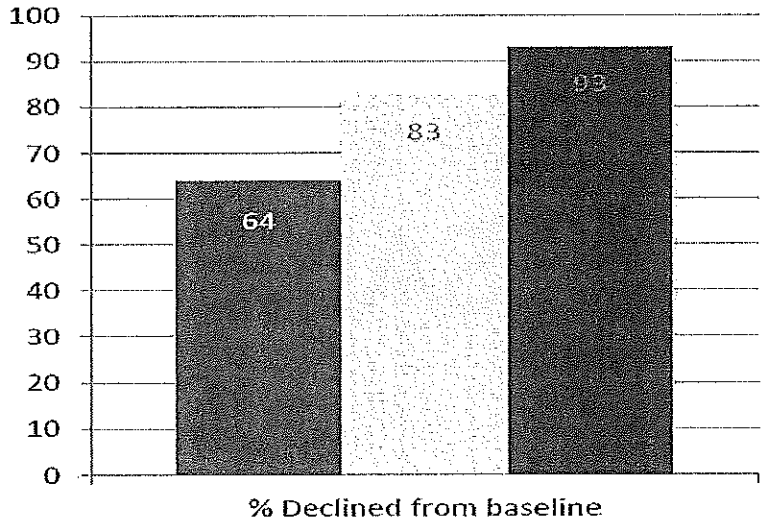
SAC Delayed Recall[4]

Delayed recall score of 5

Value added of neurocognitive evaluation

N = 122 concussed high school and collegiate athletes tested with 2 days of injury

Neurocognitive testing increases diagnostic yield to 93%



van Kampen et al., 2006

- Module 1: Word Memory
- Module 2: Design Memory
- Module 3: X's and O's
- Module 4: Symbol Matching
- Module 5: Color Match
- Module 6: Three Letter Memory

ImPACT™

SANDWICH

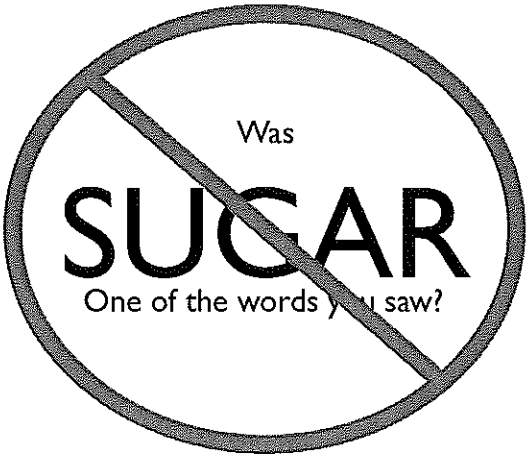
LETTUCE

MONKEY

Was

SUGAR

One of the words you saw?



Was

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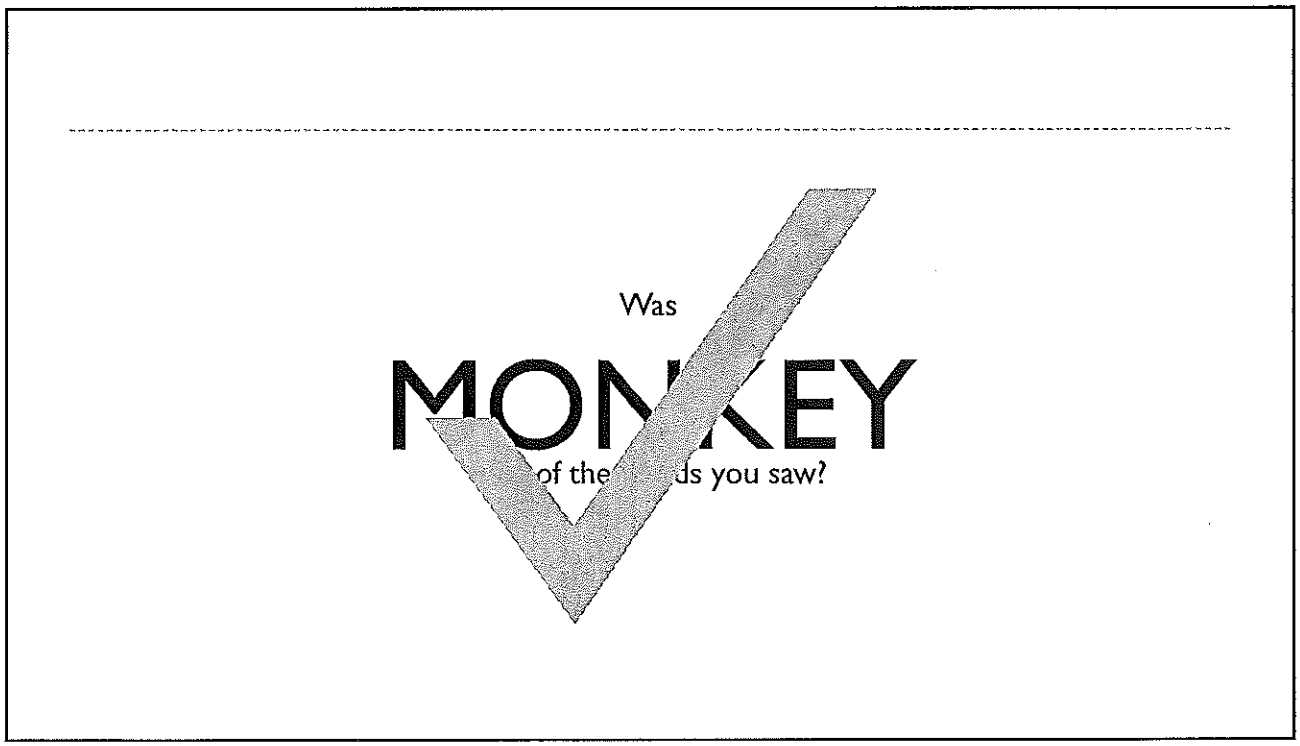
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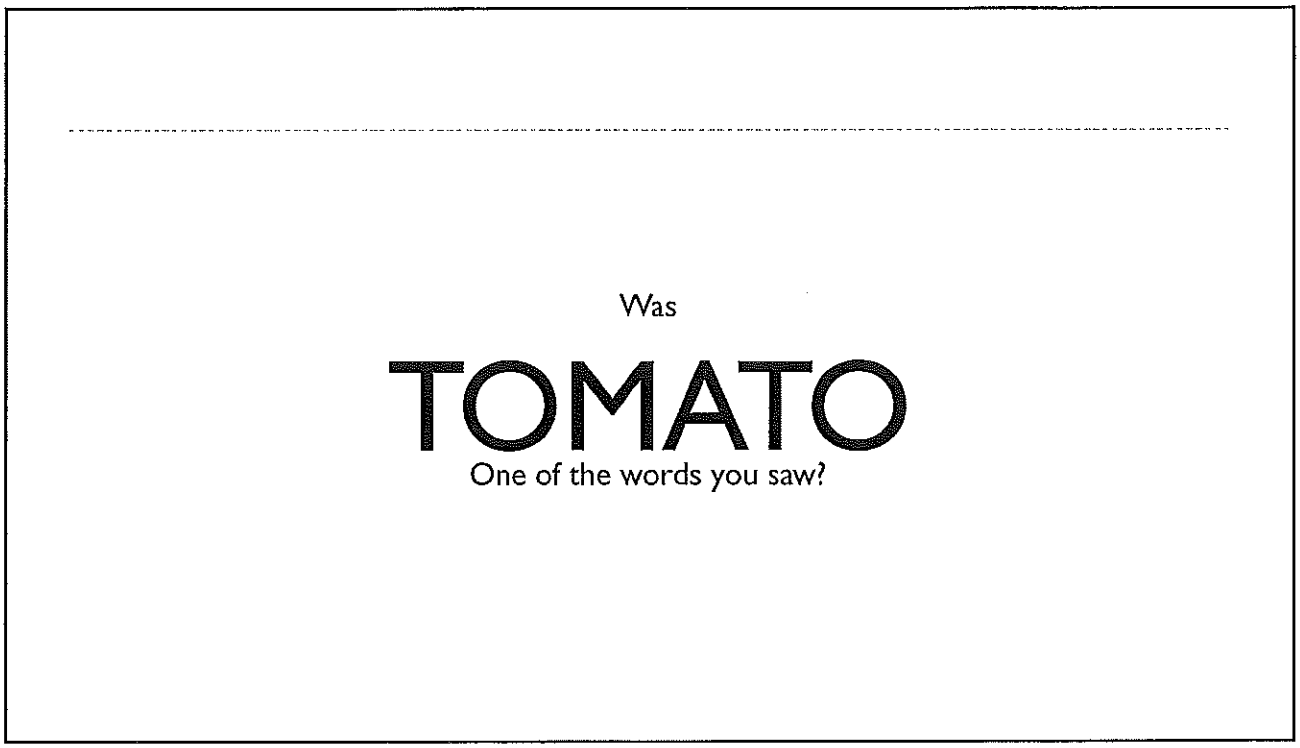
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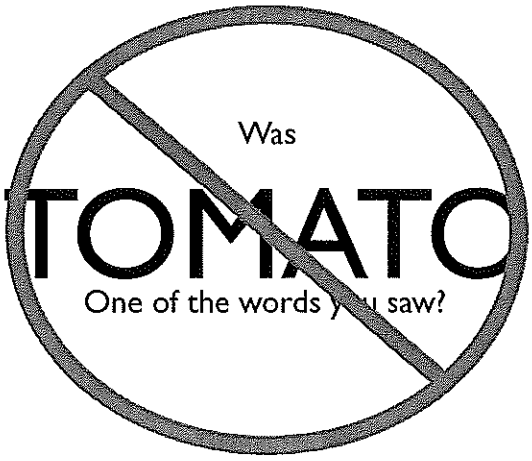
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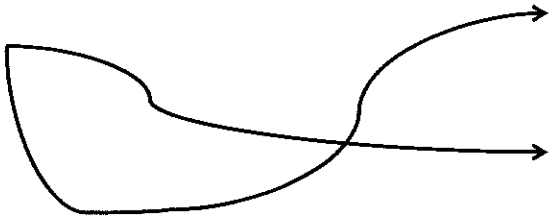

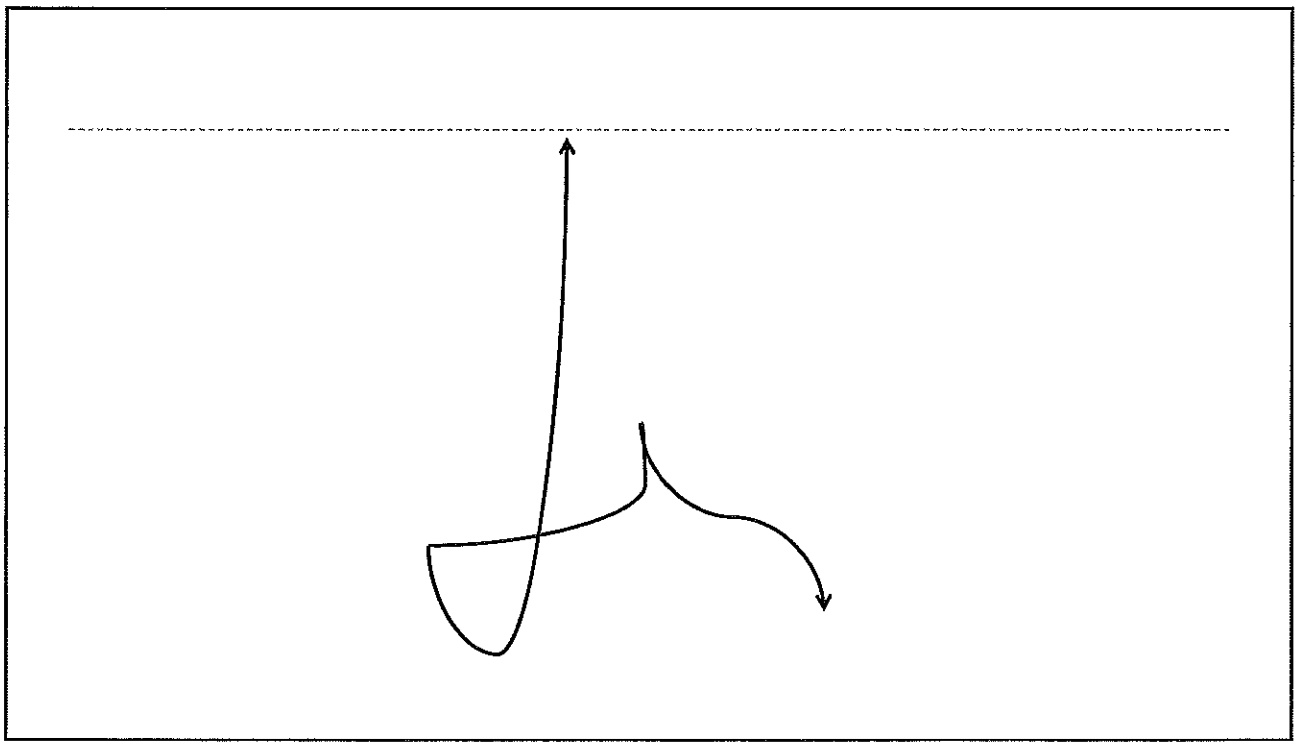

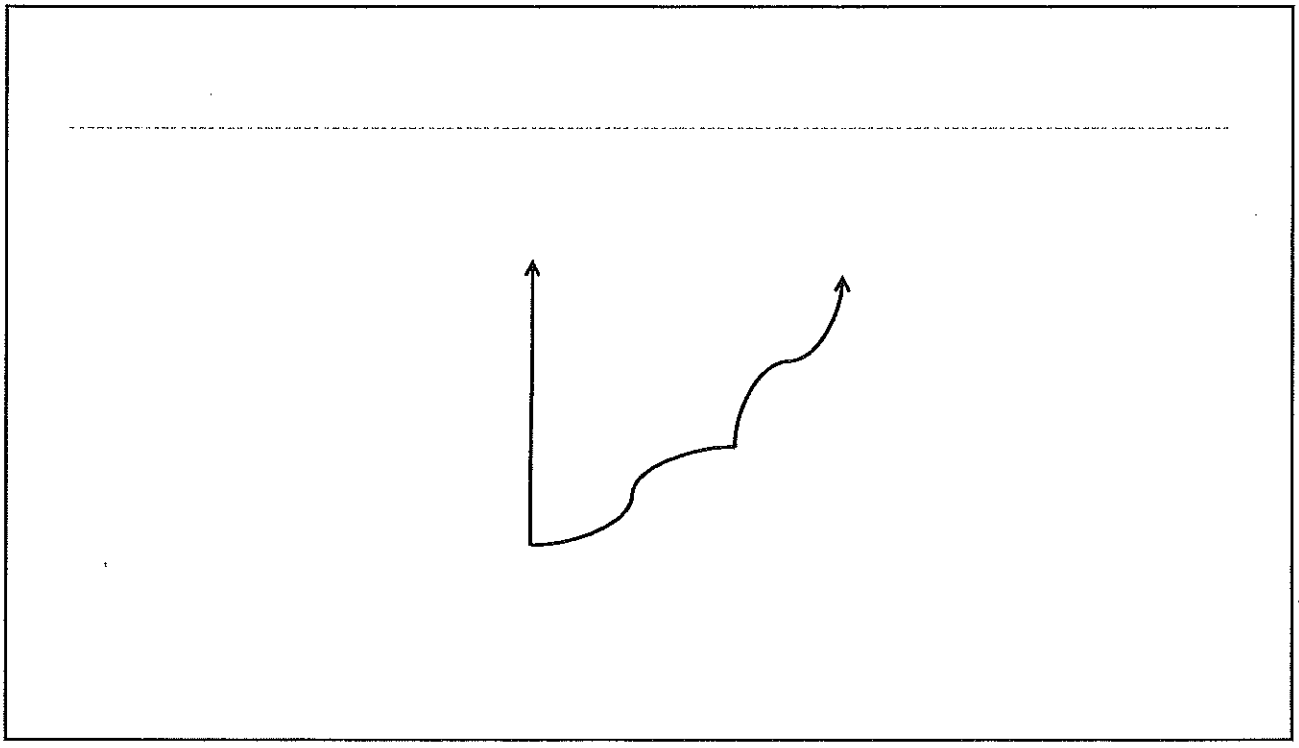

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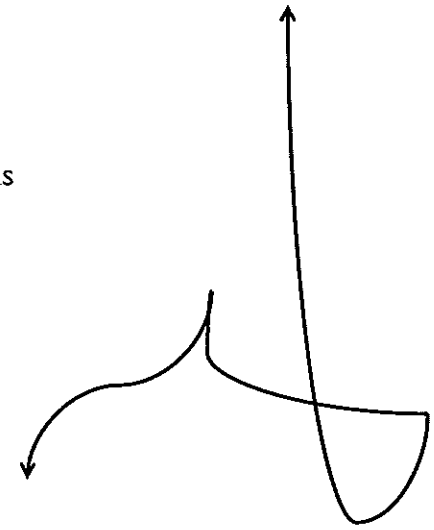

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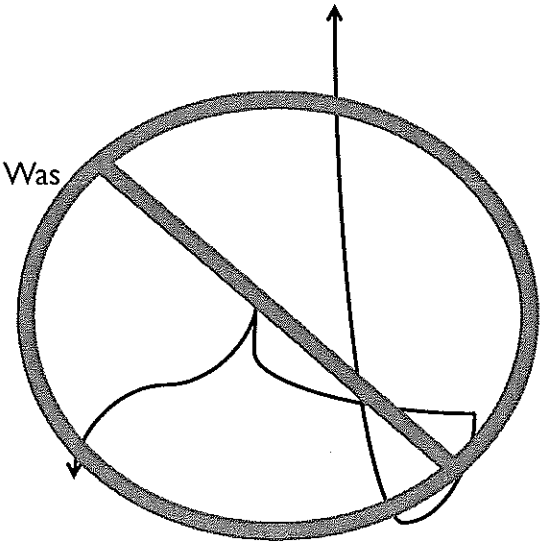

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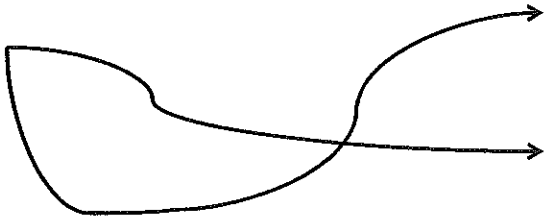

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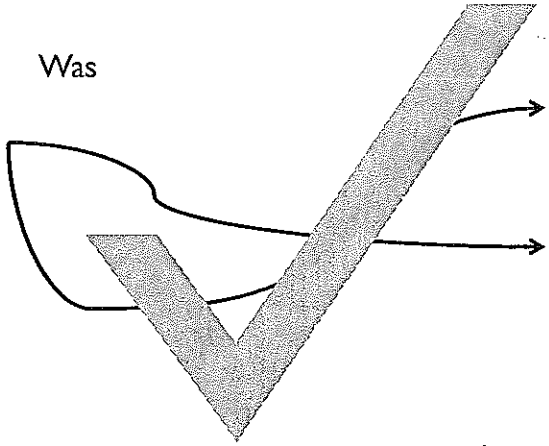

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One of the shapes you saw?

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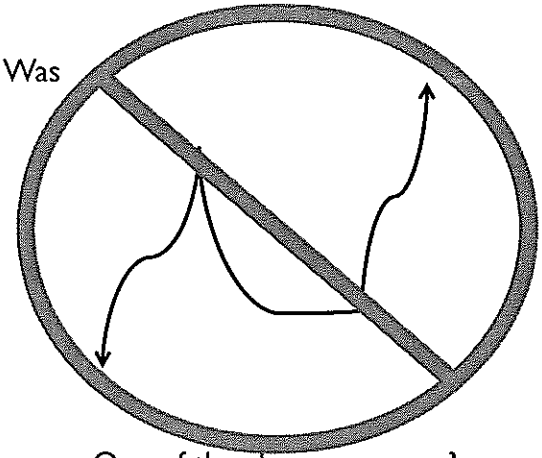

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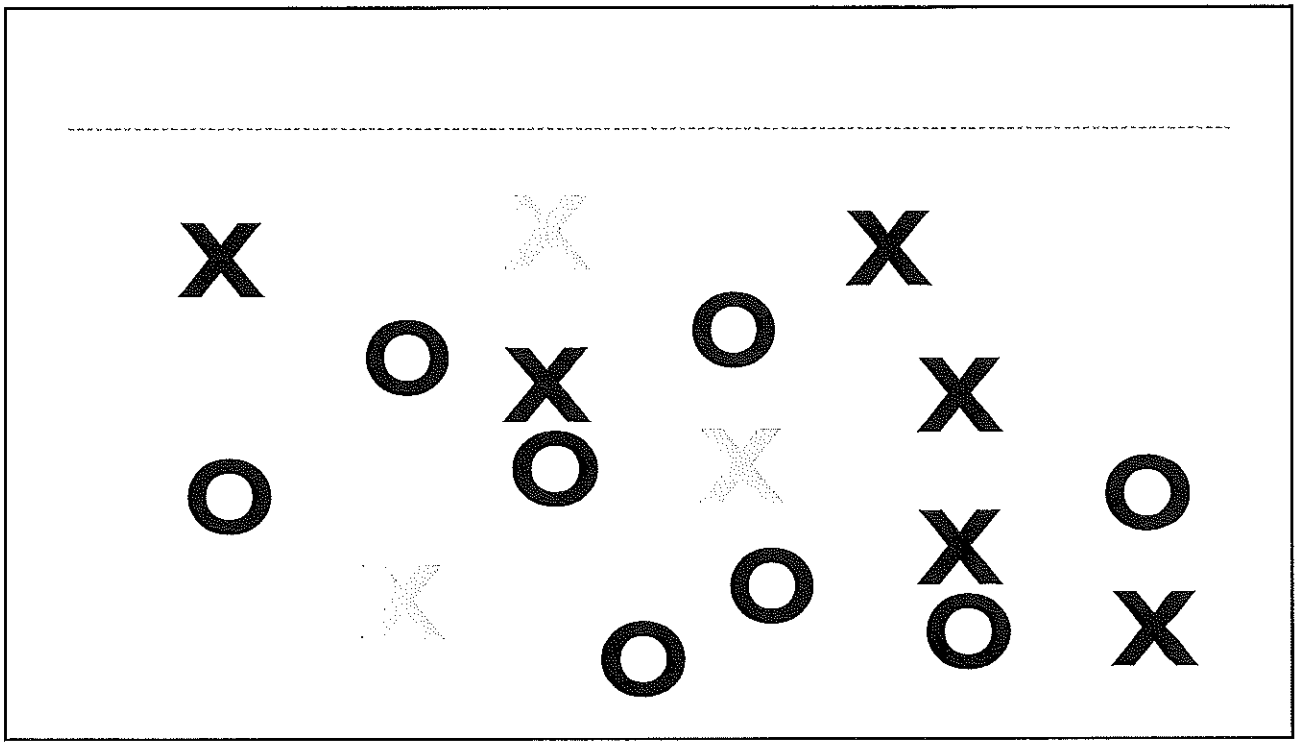

Raise your right hand if the box is red with the word RED in it and raise your left hand if the box is blue with the word BLUE in it. Do not raise your hand if the color of the box does not correspond to the color written in the box

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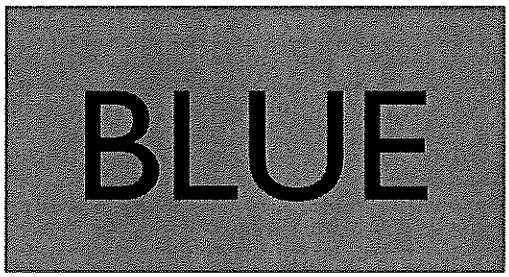

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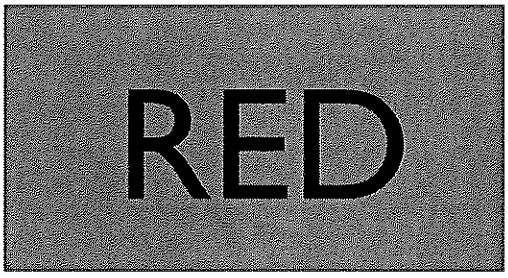

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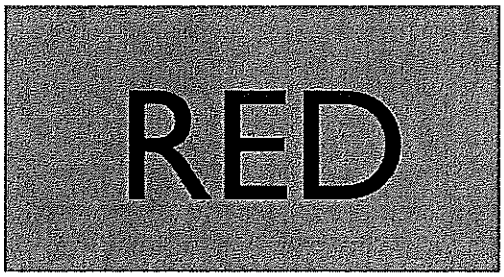

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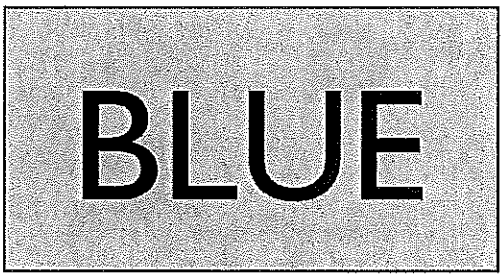
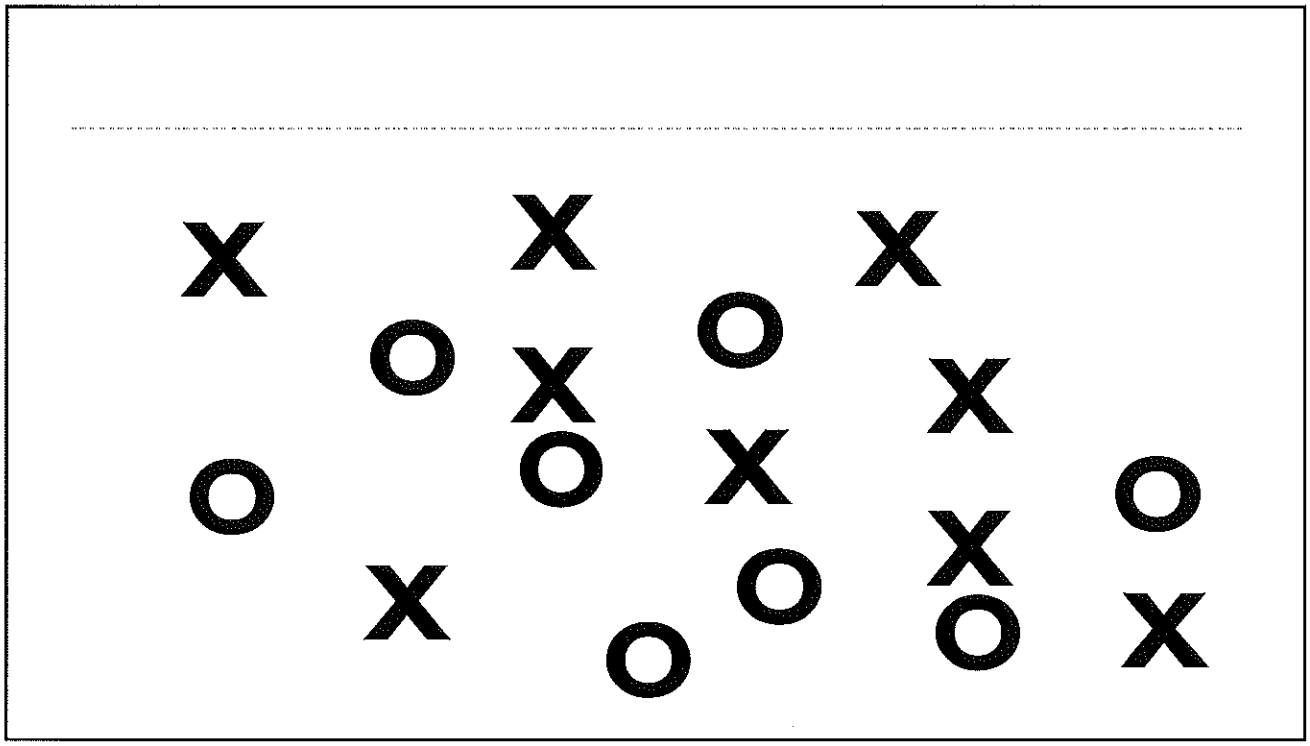
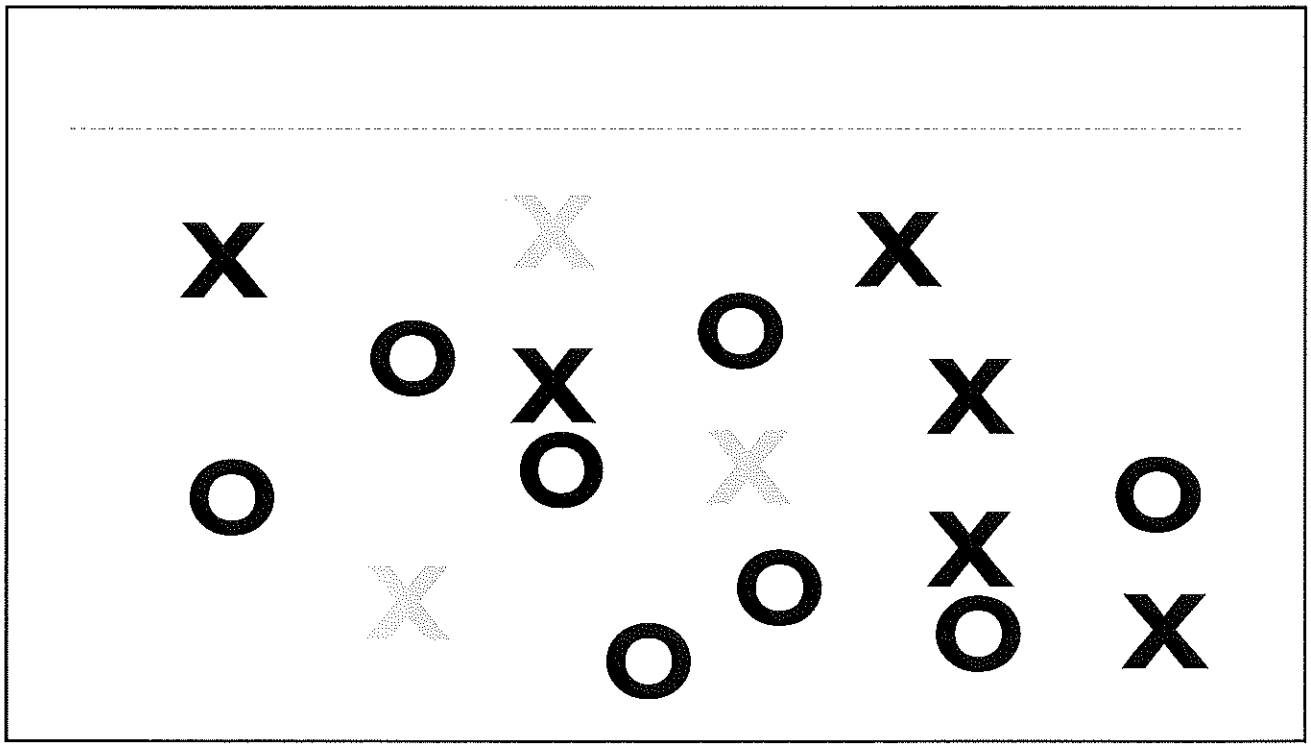






What number corresponds to the symbol Δ

%	∞	∑	Δ	☒	$	⚐	☆	§	⍁
1	2	3	4	5	6	7	8	9	10

What number corresponds to the symbol Δ

%	∞	∑	Δ	☒	$	⚐	☆	§	⍁
1	2	3	4	5	6	7	8	9	10

What number corresponds to the symbol ⚑

%	∞	∑	Δ	☒	$	⚑	☆	§	⇙
1	2	3	4	5	6	7	8	9	10

What number corresponds to the symbol ⚑

%	∞	∑	Δ	☒	$	⚑	☆	§	⇙
1	2	3	4	5	6	7	8	9	10

What number corresponds to the symbol ☆

1	2	3	4	5	6	7	8	9	10

What number corresponds to the symbol ☆

							☆		
1	2	3	4	5	6	7	8	9	10

What number corresponds to the symbol %

1	2	3	4	5	6	7	8	9	10

What number corresponds to the symbol %

%									
1	2	3	4	5	6	7	8	9	10

Remember these letters in order

A U Y

Count down from 25 to 1 as quickly as possible.

21	7	14	19	24
10	25	18	13	9
15	1	5	22	3
4	16	8	2	17
20	12	23	6	11

What were the letters shown previously?

_ _ _

Remember these letters in order

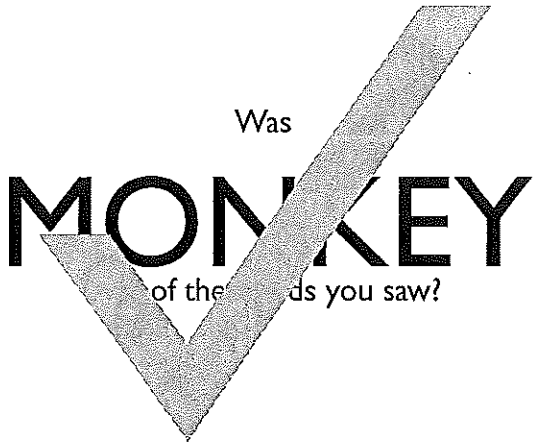
A U Y

Was

MONKEY

One of the words you saw?

Was



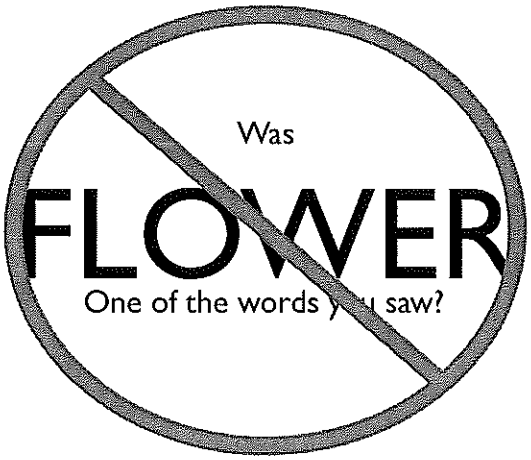
MONKEY

of the ds you saw?

Was

FLOWER

One of the words you saw?

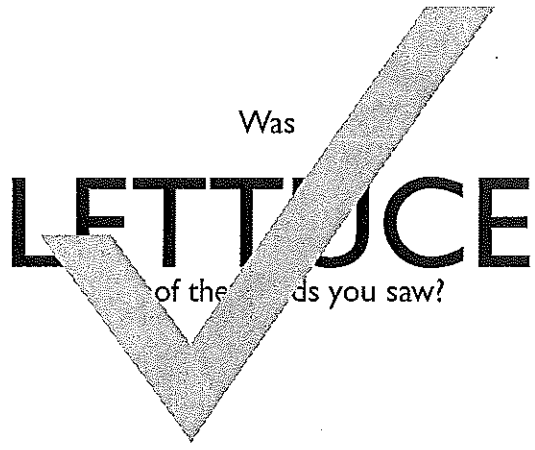


Was

LETTUCE

One of the words you saw?

Was



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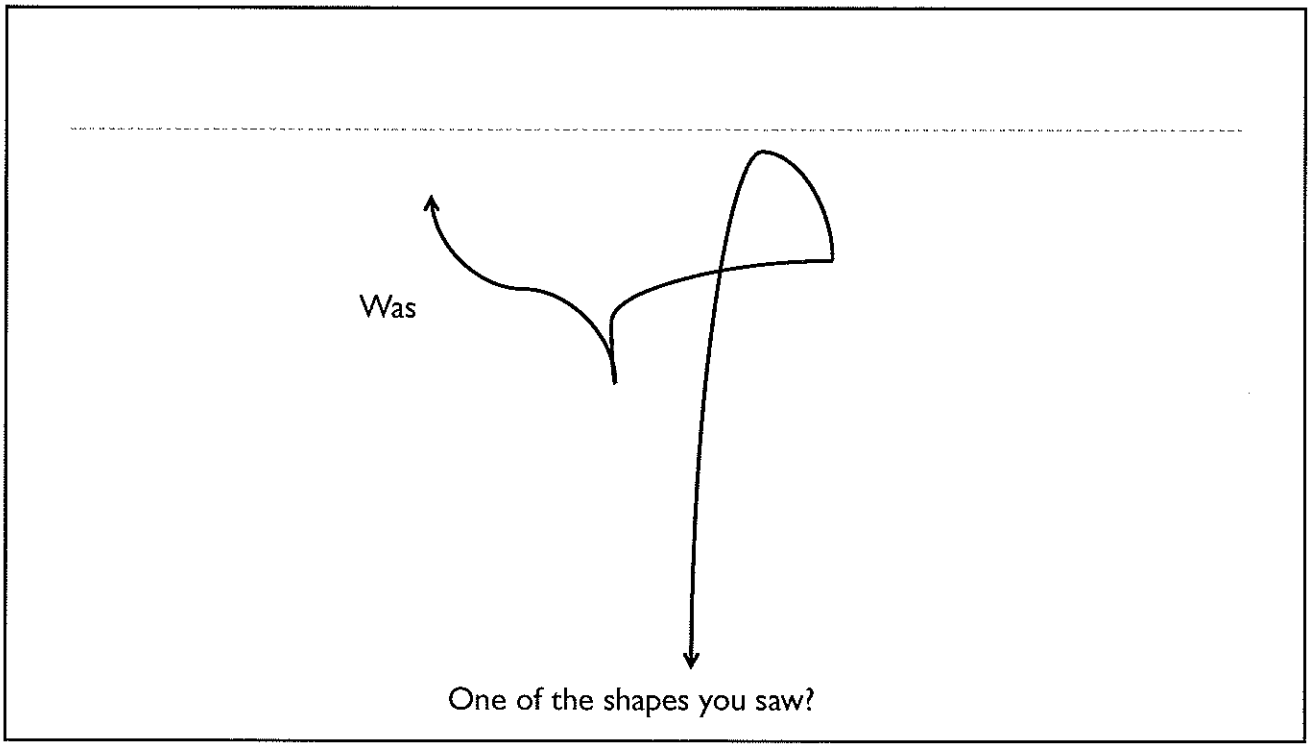
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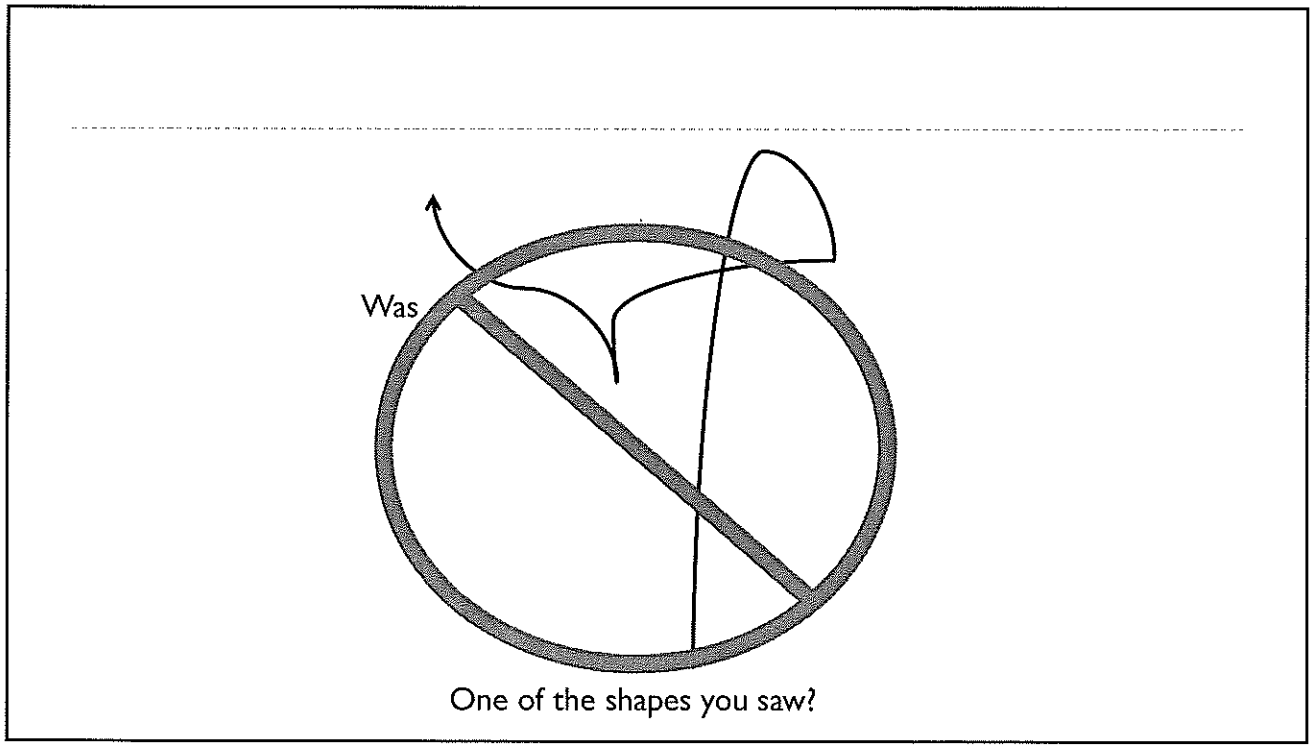
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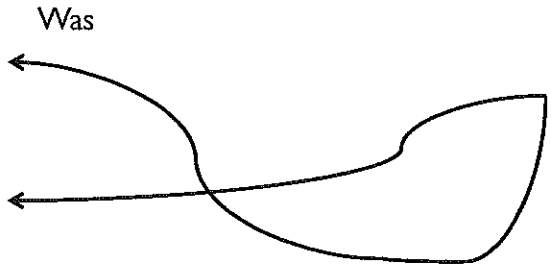

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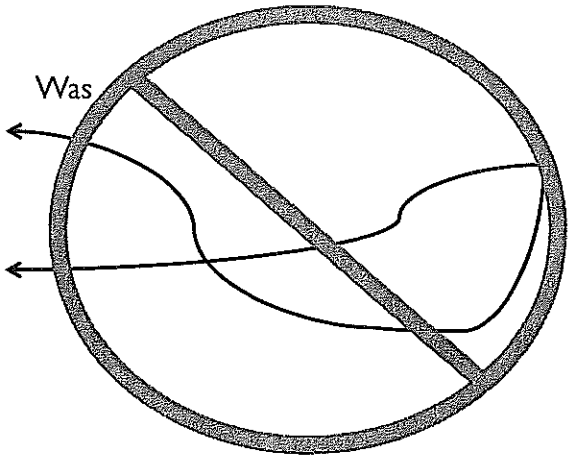

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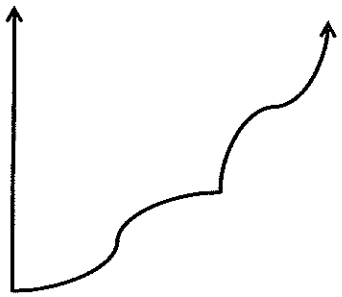
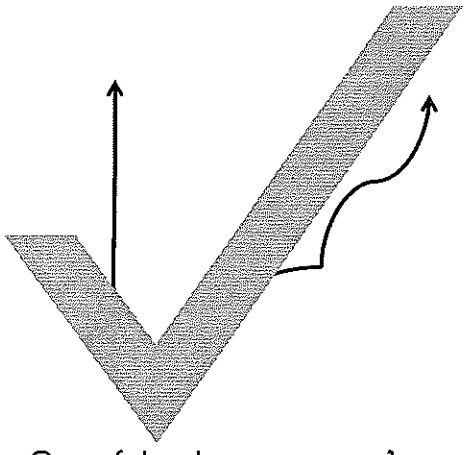


One of the shapes you saw?

Was



One of the shapes you saw?

Example of Textbook Neuropsychological Testing Profile

	Baseline	6 days post injury	9 days post injury	16 days post injury
Verbal Memory	81%	28%	66%	77%
Visual Memory	92%	24%	92%	90%
Visual Motor Speed	95%	76%	70%	93%
Reaction Time	68%	<1%	12%	79%
Impulse Control	2	5	7	2
Total Symptom Score	0	12	0	0

Real World Neuropsychological Testing

Exam Type	Baseline	Post-Injury 1	Baseline	Post-Injury 3	Post-Injury 4
Date Tested	12/12/2011	09/01/2012	09/11/2012	10/08/2012	12/05/2012
Last Concussion		04/28/2012	06/08/2012	10/04/2012	10/04/2012
Exam Language	English	English	English	English	English
Test Version	2.1	2.1	2.1	2.1	2.1

Composite Scores	Percentile scores if available are listed in small type.								
Memory composite (verbal)	99	99%	45	<1%	62	2%	51	<1%	64	3%
Memory composite (visual)	79	63%	35	<1%	57	10%	26	<1%	30	<1%
Visual motor speed composite	38.95	70%	19.63	<1%	36.5	52%	21.05	<1%	26.92	6%
Reaction time composite	0.54	73%	0.79	3%	0.59	56%	0.65	28%	0.81	2%
Impulse control composite	8		22		5		35		23	
Total Symptom Score	8		50		13		26		8	
Cognitive Efficiency Index:	0.59		0.11		0.39		0.16		0.23	

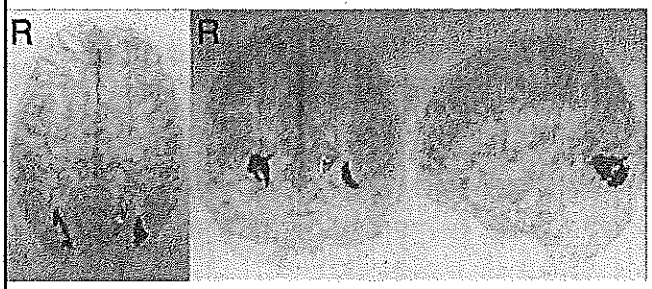
Baseline Testing

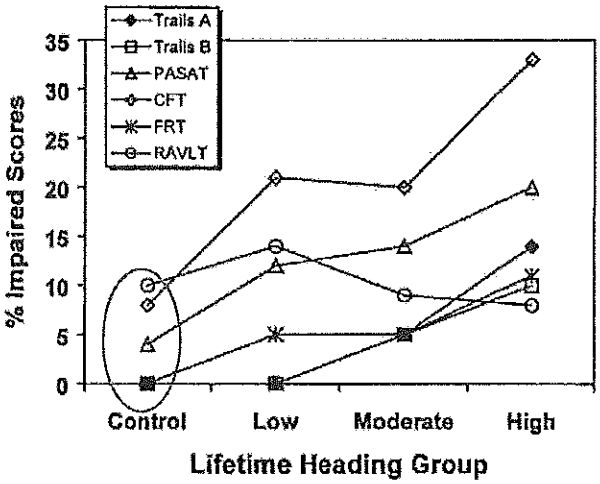
- Baseline testing is a pre-season exam conducted by a trained health care professional. Baseline tests are used to assess an athlete's balance and brain function (including learning and memory skills, ability to pay attention or concentrate, and processing speed), as well as for the presence of a symptoms.
- Results from baseline tests (or pre-injury tests) can be used and compared to a similar exam during the season if an athlete has a suspected concussion.
- Comparison can help raise a red-flag for pre-existing cognitive struggles.

The Challenges of Baseline Testing

- Test-retest reliability is low on many commercially available computer tests (even baselines shift).
- Test taking environments vary.
- Poor effort (sand bagging) has been documented in greater than 11% of high school athletes. *(Hunt, 2007)*
- Large sample studies have failed to demonstrate the incremental value of baseline testing compared to normative group testing.
- It sounds good on paper but empirical support is still lacking.

Soccer Headers >1,000/year





Lipton et al., Radiology:Volume 268: Number 3—September 2013
Witol & Webbe, Archives of Clinical Neuropsychology 18 (2003) 397–417

An Exclamation Point on Motivation and Baseline Testing

- Despite having knowledge about the symptoms and danger of concussions, many HS football athletes in our sample did not have a positive attitude toward reporting symptoms or abstaining from play after a concussion. (Anderson, 2015Clinical Journal of Sports Medicine)

Summary Points on Cognition and Concussion

- Neuropsychological screening immediately following the injury is as important as symptom reports.
- As the injury progresses, neuropsychological testing becomes less sensitive but patient and collateral symptom report remains a strong marker of recovery.
- Serial neuropsychological testing is likely not necessary but comprehensive assessment of cognitive, physiological, and somatic symptom recovery over time is essential.
- Comprehensive neuropsychological testing is **reserved for patients with strong suspicion for underlying mental health, developmental, and learning comorbidities.**

Mental Health Adages in Concussion

- The more challenging patient is the child whose symptoms persist for weeks or develop over time.
- A common theme in working with TBI patients is that brain injuries tend to exacerbate preexisting conditions.
- Inverse relationship between injury severity and mental health issues.
- Good history taking is the foundation for good mental health management.

Moderators of Recovery for TBI

Physical

- Severity of injury (primary and secondary)
- Age of onset
- Gender (though less significant when controlling for SES)
- Genetics (APOE)?
- Pre-existing medical issues

Psychosocial

- Premorbid cognitive level (IQ) of functioning
- Premorbid behavioral characteristics
- Prior academic and interpersonal skill level
- Prior mental health history
- Prior and post injury family environment
- Perception of deficits
- Amount of education about the injury
- Socioeconomic disadvantage and/or ethnic minority status may be associated with worse outcomes

Acute Concussion Evaluation (ACE)

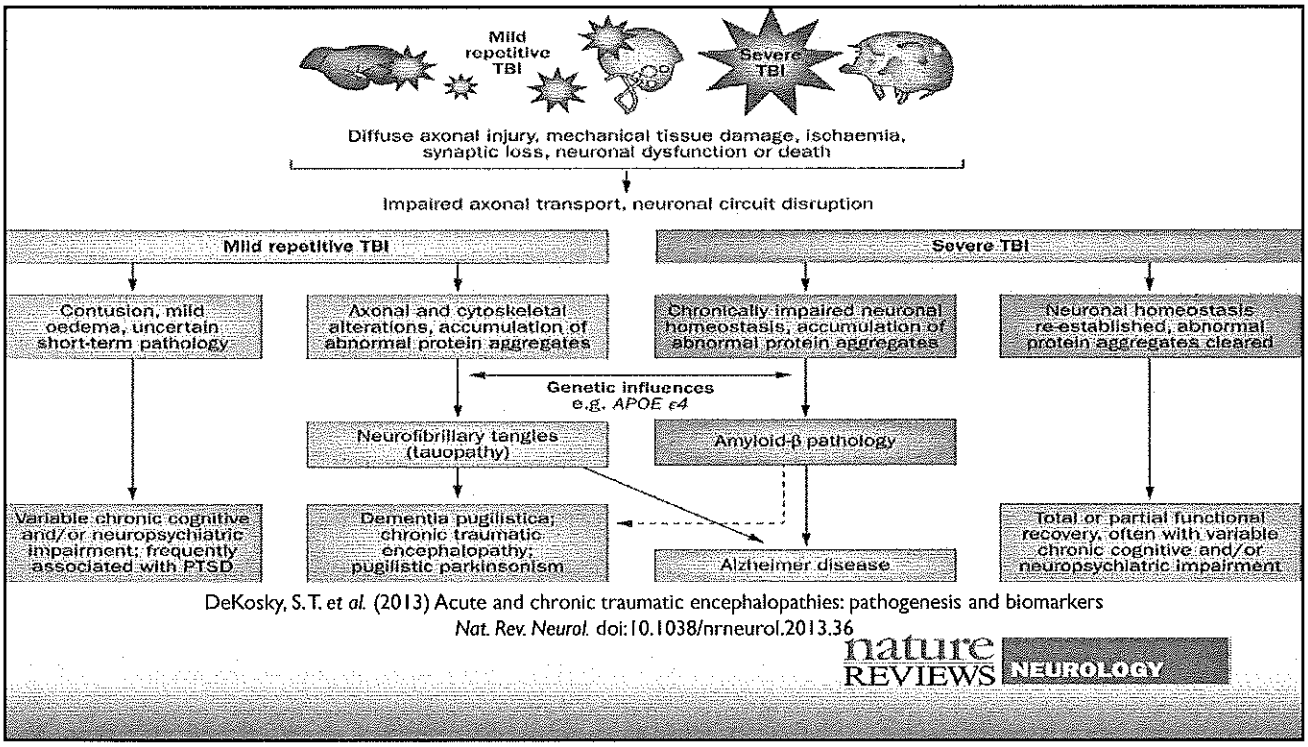
Physician/Clinician Office Version

Gerard Gioia, PhD[1] & Micky Collins, PhD[2]
[1]Children's National Medical Center
[2]University of Pittsburgh Medical Center

C. Risk Factors for Protracted Recovery *(check all that apply)*

Concussion History? Y___ N___	√	Headache History? Y___ N___	√	Developmental History	√	Psychiatric History
Previous # 1 2 3 4 5 6+		Prior treatment for headache		Learning disabilities		Anxiety
Longest symptom duration Days___ Weeks___ Months___ Years___		History of migraine headache ___ Personal ___ Family_____		Attention-Deficit/ Hyperactivity Disorder		Depression
						Sleep disorder
If multiple concussions, less force caused reinjury? Yes___ No___				Other developmental disorder_____		Other psychiatric disorder _____

List other comorbid medical disorders or medication usage (e.g., hypothyroid, seizures)_____



DeKosky, S. T. *et al.* (2013) Acute and chronic traumatic encephalopathies: pathogenesis and biomarkers *Nat. Rev. Neurol.* doi:10.1038/nrneurol.2013.36

nature REVIEWS NEUROLOGY

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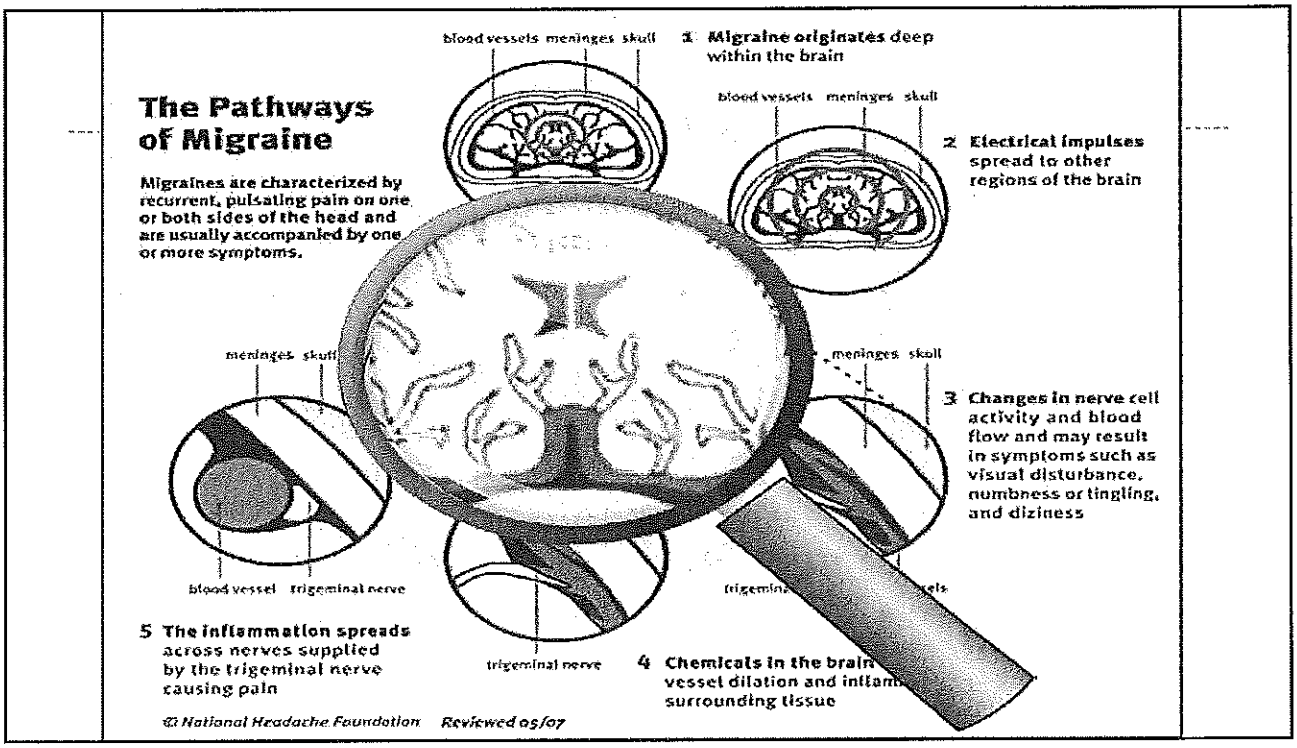

ACUTE CONCUSSION EVALUATION (ACE)

PHYSICIAN/CLINICIAN OFFICE VERSION

Gerard Gioia, PhD[1] & Micky Collins, PhD[2]
[1]Children's National Medical Center
[2]University of Pittsburgh Medical Center

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Longest symptom duration Days__ Weeks__ Months__ Years__		History of migraine headache __ Personal __ Family_____		Attention-Deficit/ Hyperactivity Disorder		Depression
						Sleep disorder
If multiple concussions, less force caused reinjury? Yes__ No__				Other developmental disorder_____		Other psychiatric disorder _____

List other comorbid medical disorders or medication usage (e.g., hypothyroid, seizures)_____

ADHD and Concussion

- In a Division I college football study of 139 athletes, 18.0% reported a prior history of at least one concussion.
- 10% reported a prior Dx of ADHD.
- 50.4% of athletes with ADHD reported a history of at least one prior concussion vs 14.4% of athletes without ADHD.
- Analyses showed that athletes with ADHD were more likely to report a past history of concussions than those without ADHD

Alosco, 2014 Brain Injury

ADHD and LD and Concussion

- ADHD and LD were associated with 2.93 and 2.08 times the prevalence, respectively of concussions
- In players without histories of concussion, individuals with ADHD reported more baseline symptoms, and ADHD and LD were associated with poorer performance on baseline cognitive tests.
- Interactive effects were present between ADHD/LD status and concussion history for self-reported symptoms.
- Although not statistically significant, youth athletes with ADHD took on average 3 days longer to return to baseline neurocognitive testing compared with a control group without ADHD.

(Nelson, 2015. Clinical Journal of Sports Medicine).

ACUTE CONCUSSION EVALUATION (ACE)

PHYSICIAN/CLINICIAN OFFICE VERSION

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[1]Children's National Medical Center
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C. Risk Factors for Protracted Recovery *(check all that apply)*

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Previous # 1 2 3 4 5 6+		Prior treatment for headache		Learning disabilities		Anxiety
Longest symptom duration Days___ Weeks___ Months___ Years___		History of migraine headache ___ Personal ___ Family_____		Attention-Deficit/ Hyperactivity Disorder		Depression Sleep disorder
If multiple concussions, less force caused reinjury? Yes___ No___				Other developmental disorder_____		Other psychiatric disorder

List other comorbid medical disorders or medication usage (e.g., hypothyroid, seizures)_____

Mental Health Management of Concussion

- The more challenging patient is the child whose symptoms persist for weeks or develop over time, or, even more complicated, the child who had preexisting known or unknown mental health issues.
- A common theme in working with TBI patients is that brain injuries tend to exacerbate preexisting conditions.
- Good history taking is the foundation for good mental health management.

Depression and Anxiety in Concussion

SYMPTOM EVALUATION

How do you feel?

"You should score yourself on the following symptoms, based on how you feel now"

	none	mild		moderate		severe
Headache	0	1	2	3	4	5	6
"Pressure in head"	0	1	2	3	4	5	6
Neck Pain	0	1	2	3	4	5	6
Nausea or vomiting	0	1	2	3	4	5	6
Dizziness	0	1	2	3	4	5	6
Blurred vision	0	1	2	3	4	5	6
Balance problems	0	1	2	3	4	5	6
Sensitivity to light	0	1	2	3	4	5	6
Sensitivity to noise	0	1	2	3	4	5	6
Feeling slowed down	0	1	2	3	4	5	6
Feeling like "in a fog"	0	1	2	3	4	5	6
"Don't feel right"	0	1	2	3	4	5	6
Difficulty concentrating	0	1	2	3	4	5	6
Difficulty remembering	0	1	2	3	4	5	6
Fatigue or low energy	0	1	2	3	4	5	6
Confusion	0	1	2	3	4	5	6
Drowsiness	0	1	2	3	4	5	6
Trouble falling asleep	0	1	2	3	4	5	6
More emotional	0	1	2	3	4	5	6
Irritability	0	1	2	3	4	5	6
Sadness	0	1	2	3	4	5	6
Nervous or Anxious	0	1	2	3	4	5	6

Total number of symptoms (Maximum possible 22)

Symptom severity score (Maximum possible 132)

Do the symptoms get worse with physical activity? Y N

Do the symptoms get worse with mental activity? Y N

self rated — self rated and clinician monitored

clinician interview — self rated with parent input

Overall rating: If you know the athlete well prior to the injury, how different is the athlete acting compared to his/her usual self?

Please circle one response:

not different — very different — unsure — N/A

- Several symptoms overlap with depression/anxiety.
  - Feeling slowed down.
  - Feeling in a "fog."
  - "Don't feel right."
  - Difficulty concentrating and difficulty remembering.
  - Fatigue or low energy.
  - Drowsiness
  - Trouble falling asleep
  - More emotional
  - Irritability
  - Sadness
  - Nervous or anxious
- ➢ All symptoms can be heightened by depression/anxiety.

Depression and Concussion

- Concussed athletes exhibited significantly higher levels of depression from baseline at 2 days (*P*.001), 7 days (*P*.006), and 14 days postconcussion (*P*.04).
- Somatic depression at 7 days postconcussion was related to slower reaction time and lower visual memory scores at 14 days post injury.

Kontos et al., Arch Phys Med Rehabil 2012

Depression and Concussion

- Approximately one-fifth of concussed athletes (n = 14, 19.8%) reported experiencing symptoms of depression, and over one-third (n = 24, 33.8%) reported experiencing anxiety.
- Ten (14.1%) concussed athletes reported experiencing both depression and anxiety.

Yang et al., 2015 Developmental Neuropsychology, 40:1, 18-23

Depression and Concussion

- Concussed athletes who had symptoms of depression at baseline (pre-injury) were 4.59 times more likely to experience depression symptoms and 3.40 times more likely to experience state anxiety following the concussion, compared to concussed athletes who had no symptoms of depression at baseline.

Yang et al., 2015 Developmental Neuropsychology, 40:1, 18-23

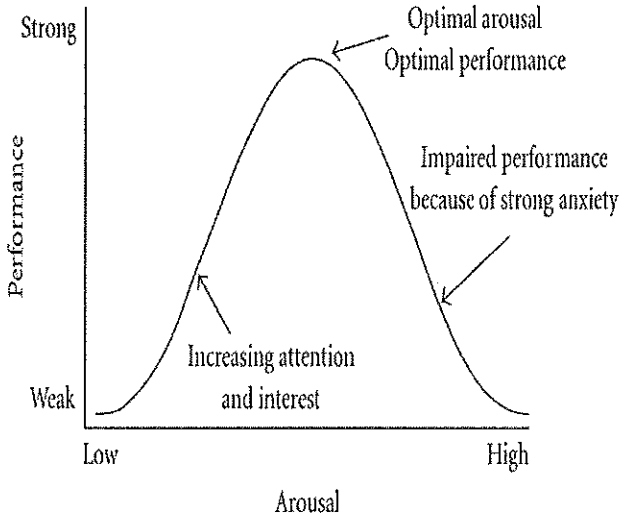
Depression and Concussion

- In a study of retired National Football League (NFL) players, responses to questions regarding clinical depression revealed that 269 of 2434 respondents reported a previous diagnosis of clinical depression.
- In comparison to retired NFL players with no history of concussion, retired players with a history of one or two previous concussions were 1.5 times more likely to be diagnosed with depression, while those with a history of three or more previous concussions were found to be three times more likely to be diagnosed with depression.

Guskiewicz KM, Marshall SW, Bailes J, et al. Recurrent concussion and risk of depression in retired professional football players. Med Sci Sports Exercise 2007;39:903–9

Anxiety and Concussion Recovery

- Anxiety symptoms can impact cognitive functioning as well as interfere with compliance with treatment recommendations.
- Anxiety can amplify concussion symptoms (autonomic stimulation).
- Anxiety symptoms can prolong recovery.
- Prolonged recovery can lead to increased absences, falling behind academically, and social isolation, which can exacerbate anxiety.



PTSD

- Although fairly uncommon in pediatric concussion, the circumstances of a concussion can result in posttraumatic stress disorder (PTSD) or acute stress disorder, particularly when considering that concussions do not have to result in loss of consciousness during the event.
- It is important to at least screen for PTSD in situations in which there is the strong potential for this (in other words, an event that involved threatened death or serious injury to self or other, was the result of an assault, and resulted in intense fear or horror).
- Some symptoms to look for include intense psychological distress, recurrent distressing recollection, and frequent nightmares of the event, flashbacks, hypervigilance, and exaggerated startle response, and feelings of detachment from others.
- If these symptoms are present, a mental health evaluation and treatment would be the next logical step.

Symptom Exaggeration

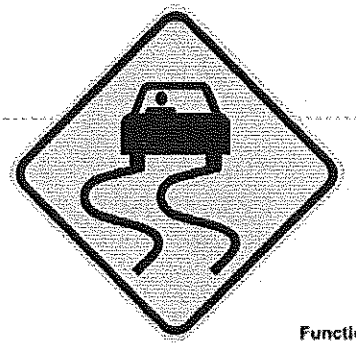
- Of a sample of 191 patients ages 8 to 17 evaluated following mTBI, 12% exhibited failure rates on performance validity tasks.
- Non-credible performance was **not** associated with age, gender, type or severity of injury, litigation status, or premorbid learning disability or psychiatric diagnosis.
- Greater total symptom scores were associated with suboptimal effort.
- Children with non-credible performance have a lengthier recovery.

Kirkwood 2014, Pediatrics

Symptom Exaggeration

- Persistent post concussive syndrome is rare, even in pediatrics.
- Alternative medical explanations need to be considered.
- Do the reports of cognitive difficulties match the presentation?
- Many "postconcussive" symptoms are driven by non-injury characteristics (misattribution).
- Conscious or subconscious secondary gain must be considered (What is the patient trying to tell me?)
- It is **not** malingering until proven otherwise.

The Road to Recovery



Premorbid child factors
- Behavioral adjustment
- Cognitive status
- School performance

Post-injury child factors
- Coping strategies
- Cognitive changes

Injury characteristics
- Complicated versus uncomplicated
- Other indices of severity

Post-concussive symptoms
- Cognitive/somatic
- Emotional/behavioral

Functional outcomes
- Days of school missed
- School performance
- Physical health
- Health care utilization
- Activity restrictions

Premorbid family factors
- Family functioning
- Other stressor and resources

Post-injury family factors
- Parent adjustment
- Perceived family burden
- Other stressors and resources

Key questions include:

- Is there a preexisting history of learning disability and/or attention-deficit/hyperactivity disorder (ADHD)?
- Are there preexisting or current family stressors?
- Has the child ever been in therapy before?
- How much school has the child missed?
- How has the school responded to the child missing tests and assignments?
- Is the child being pressured by teachers or coaches to return to activity?

The answer to these and other questions will dictate how mental health issues should be addressed.

Themes in Managing Mental Health needs in Concussion

- The treatment strategy for managing the emotional and mental health needs of the adolescent concussion patient is dictated by the underlying etiology.
- It is reasonable to suspect that irritability, a short fuse, and frequent crying during the first few days following injury are a direct result of neurologic disruption, which are not amenable to reason and behavioral interventions. In these cases, the best treatment is to educate the family that this is a transient neurologic state, while ensuring that the patient is protected from environmental stressors.
- One analogy that parents and patients find helpful is "weathering the storm," and with time, these symptoms tend to abate. The key here is to normalize the recovery process and provide parents with a realistic recovery trajectory.

Potentially Treatable Psychological factors of Concussion Recovery

- Knowledge - the early provision of information related to concussion diagnosis and possible symptoms, normalization of symptoms, reassurance of positive expectation of recovery, and education on coping strategies.
- Self-efficacy - the individual's belief in their ability to overcome adversity, effect change, and reach goals.
- Attribution - the extent to which one attributes symptoms to concussion versus other causes.

Belanger et al. (2013) The Clinical Neuropsychologist

Mental Health Treatment Strategies

- Normalize the experience.
  - This is an injury and not brain damage.
  - Unlike a sprained ankle or the flu, the brain takes time to heal.
  - Most patients return to normal, though some just take longer than others.
- Normalize ADL's
  - Sleep hygiene is essential to concussion recovery and optimal physical and mental health.
  - Subsymptomatic physical activity is essential to concussion recovery and optimal physical and mental health. "Active Recovery"
  - Mental activity is essential to concussion recovery and optimal physical and mental health

Reinforce Self-Efficacy

- Utilize examples to illustrate how persistence can lead to overcoming adversity.
- Teach strategies to overcome low confidence (fake it till you make it).
- Give the patient self advocacy tools (through education)and then reinforce the use of those tools.
- Re-conceptualize the injury.

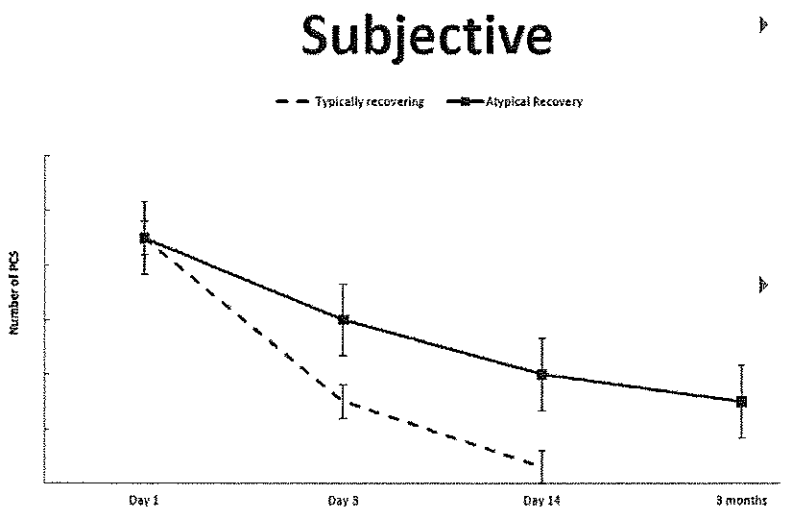
Cognitive

- Adjust the student's schedule as needed to avoid fatigue, such as a shorter school day, reduced course load or holding the most challenging classes earlier in the day.
- Adjust the environment to reduce distractions or protect the student from irritations like bright lights, talkative peers and loud places. Move the student closer to the teacher.
- Give the student extra time to finish classwork and take tests.
- Help the student create a to-do list or get organized.
- Give the student assistance: assign a peer to take notes for the student and/or allow the student to record classes.
- Break down assignments into smaller chunks and offer recognition cues.
- Provide alternate methods for a student to show mastery of a subject, such as allowing a multiple-choice or verbal test vs. an essay exam.
- Focus on what the student does well and expand the curriculum to more challenging content as symptoms subside.
- Adjust school load to prevent "piling-up" of assignments.

Behavior/Social/Emotional

- If the student is frustrated with failure in one area, redirect him or her to other curriculum areas where he or she can succeed.
- Reinforce positive behavior and academic success.
- Set reasonable expectations.
- Provide structure and consistency; make sure all teachers use the same strategies.
- Remove a student from a problem situation, but don't characterize it as a punishment.
- Involve the family in any behavior management plan.
- Acknowledge that the student may be having a hard time. Be empathetic, encouraging and patient.
- Have the student work with you to make decisions about schedule changes or prioritizing tasks.
- Irritability, low frustration tolerance or "short fuse" are common. Approach student in a non-judgmental way.

When to Refer to a Multidisciplinary Concussion Clinic



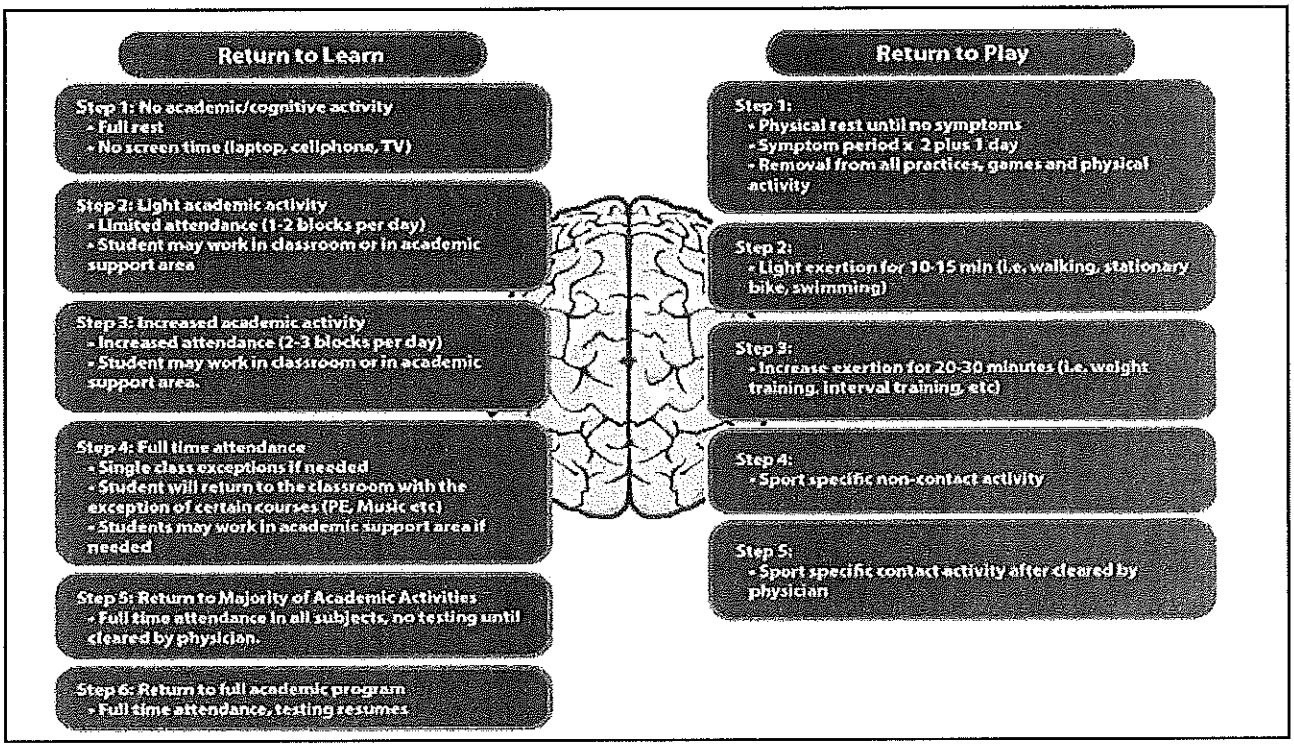
- The vast majority of concussions resolve within days to weeks.
  - 75% of in 14 days
  - 85% by 21 days
- Multidisciplinary approach for patients with protracted recovery.

Collins et al., 2006, Neurosurgery

Disparities

- A number of studies have suggested that socioeconomic disadvantage and/or ethnic minority status may also be associated with worse outcome after pediatric TBI, controlling for injury severity.
- However, in studies with extended follow-up, there is a higher attrition rate for lower SES patients.
- Furthermore, there are differences between ethnic groups in death and hospitalization rates associated with mechanism of injury, particularly in younger ages.

Anderson et al, 2004; Catroppa & Anderson 2004; Schwartz et al, 2003; Yeates et al, 2002



Returning to School

- Symptomatic students may require active supports and accommodations in school, which may be gradually decreased as their functioning improves. Inform the student's teacher(s), the school nurse, psychologist/counselor, and administrator of the student's injury, symptoms, and cognitive deficits.
- Students with temporary yet prolonged symptoms (i.e. longer than several weeks) or permanent disability may benefit from referral for special accommodations and services, such as those provided under a Section 504 Plan.

Benefits of Strict Rest After Acute Concussion: A Randomized Controlled Trial

Danny George Thomas, MD, MPH[a], Jennifer N. Apps, PhD[b], Raymond G. Hoffmann, PhD[a], Michael McCrea, PhD[c], Thomas Hammeke, PhD[b]

"Patients in our strict rest group reported more symptoms over the course of the study. Modeling revealed that group assignment was associated with high physical symptoms early and emotional symptoms throughout the study."

Acute Concussion Evaluation (ACE)

Care Plan

Gerard Gioia, PhD[1] & Micky Collins, PhD[2]
[1]Children's National Medical Center
[2]University of Pittsburgh Medical Center

Returning to School (Continued)

Until you (or your child) have fully recovered, the following supports are recommended: *(check all that apply)*

__No return to school. Return on (date)_____

__Return to school with following supports. Review on (date)_____

__Shortened day. Recommend ____ hours per day until (date)_____

__Shortened classes (i.e., rest breaks during classes). Maximum class length: _____ minutes.

__Allow extra time to complete coursework/assignments and tests.

__Lessen homework load by _____%. Maximum length of nightly homework: _____ minutes.

__No significant classroom or standardized testing at this time.

__Check for the return of symptoms (use symptom table on front page of this form) when doing activities that require a lot of attention or concentration.

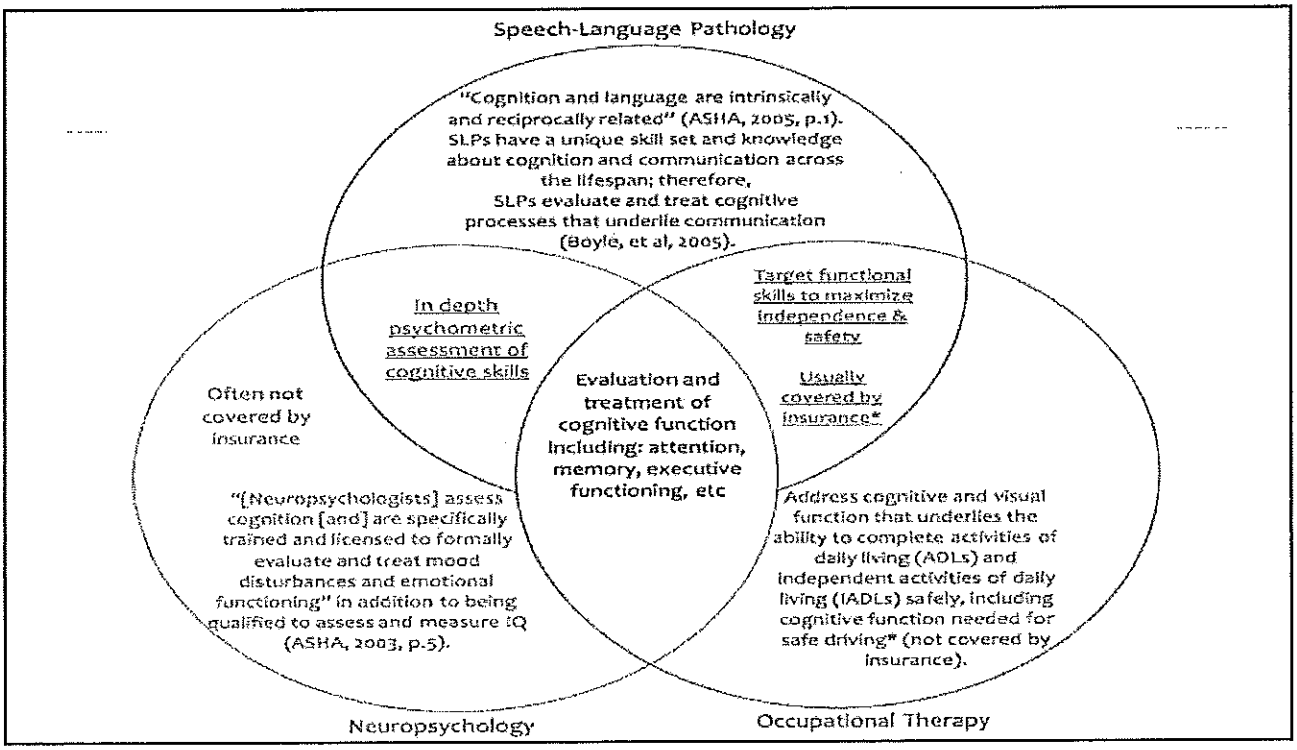
__Take rest breaks during the day as needed.

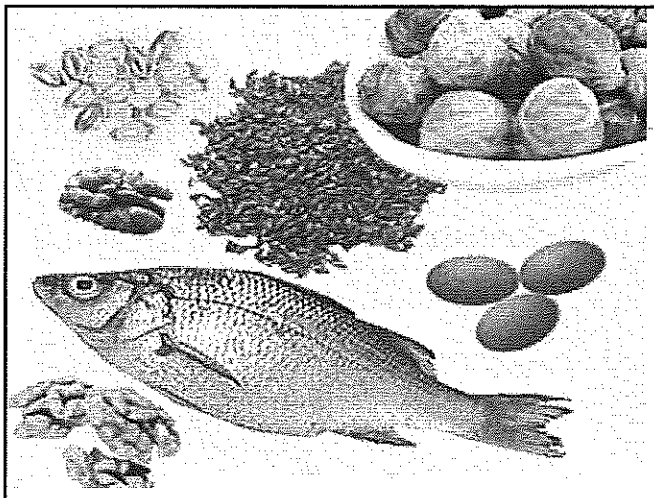
__Request meeting of 504 or School Management Team to discuss this plan and needed supports.

Rehabilitation - Cognitive

"Cognitive rehabilitation interventions are typically managed by speech therapists, occupational therapists, or neuropsychologists"

(Riechers & Ruff, 2010, p.136)





Omega 3 fatty acids

Omega-3 Research

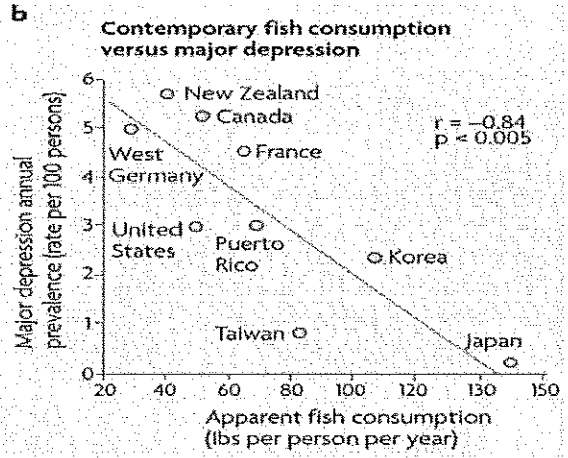
Dietary Omega-3 Fatty Acids Normalize BDNF Levels, Reduce Oxidative Damage, and Counteract Learning Disability after Traumatic Brain Injury in Rats

AIGUO WU,[1] ZHE YING,[1] and FERNANDO GOMEZ-PINILLA[1,2]

Delayed administration of ethyl eicosapentate improves local cerebral blood flow and metabolism without affecting infarct volumes in the rat focal ischemic model

Toshiya Katsumata *, Yasuo Katayama, Rimosuke Obo, Hiromi Muramatsu, Tatsuo Ohtori, Akiro Terashi

Second Department of Internal Medicine, Nippon Medical School, 1-1-5 Sendagi, Bunkyo-ku, Tokyo 113, Japan



Status	Study
Recruiting	High Dose Omega-3 Fatty Acids in the Treatment of Sport Related Concussions **Conditions:** Mild Concussion; Brain Concussion; Cerebral Concussion **Interventions:** Dietary Supplement: Docosahexaenoic acid; Other: Placebo
Not yet recruiting	DHA For The Treatment of Pediatric Concussion Related to Sports Injury **Conditions:** Concussion; Mild Traumatic Brain Injury **Intervention:** Drug: Docosahexaenoic acid (DHA)

Omega-3 Controversy

Study Shows No Benefits of Omega-3 Fatty Acids on Cognitive Decline

Fri, 09/27/13 - 16:24

A new retrospective cohort study found no association between levels of omega-3 fatty acids and age-associated cognitive decline in older women without dementia, contrary to previous research that demonstrated the potential benefits of omega-3 fatty acids on cognitive function.

Omega-3 Fatty Acids Linked to Increase in Prostate Cancer Risk

Article date: July 17, 2013

By Stacy Simon

A study conducted by researchers at cancer centers across the US has found a link between omega-3 fatty acids and an increased risk of prostate cancer. Omega-3 fatty acids are found in fish including salmon, trout, and fresh tuna, and in fish oil supplements.

The study, published online July 10 in the *Journal of the National Cancer Institute*, looked at blood levels of omega-3 fatty acids in some of the men enrolled in the Selenium and Vitamin E Cancer Prevention Trial (SELECT) of more than 35,000 men over age 50 in the US, Puerto Rico, and Canada. The study did not collect information on the men's diets. Therefore, it's not clear whether the omega-3 fatty acids in their blood came from food or from supplements.

Omega-3 Controversy

Expert Opinion: Omega-3 Fatty Acids and Bleeding—Cause for Concern?

William S. Harris, PhD

Omega-3 fatty acid ethyl esters have well-known triglyceride-lowering properties and were shown >30 years ago to inhibit platelet function. With the recent US Food and Drug Administration (FDA) approval of these agents for treating severe triglyceride elevations, concerns about excess bleeding naturally arise. However, an objective assessment of the evidence for clinically significant bleeding reveals that such concerns are unfounded. As such, the benefits of triglyceride lowering with omega-3 fatty acids more than outweigh any theoretical risks for increased bleeding. (Am J Cardiol 2007;99[suppl]:44C–46C)

~500-1000mg/day

Management of Post-Concussive Symptoms: Headache

- The most common symptom for which medication is indicated is post-concussion headache.
- As many as one third of patients report increased headaches 1 year after head trauma.
- Generally the headache (eg, tension, migraine) is similar to the type of headache the patient typically had before the trauma, with most (85%) being described as steady, aching, tension-type headaches. Migraine headaches with or without aura have been reported with less frequency after concussion .
- Adolescents participating in sports with repetitive minor head trauma such as football, hockey, and boxing can develop "footballer's migraine".

Willer & Leddy, 2006

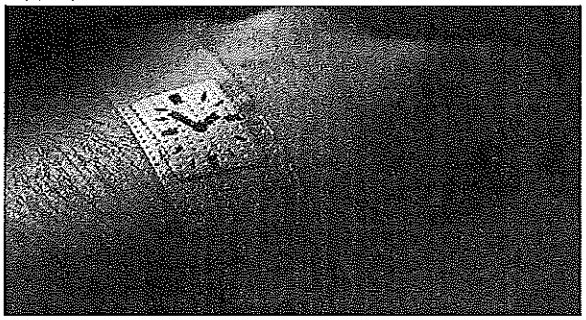
Management of Post-Concussive Symptoms: Headache

- Regional cerebral blood flow measurements using SPECT, in children with post TBI headaches, showed persistent differences over time.
- Thirty-two children were studied, aged 6-16, at 10-15 days, and then at 3 and 12 months after brain concussion. In all children no changes were found in CT and MRI examinations. In the early period after trauma, blood flow impairment was found in 21 children in the studied group, mostly in frontal areas. One year after trauma the rCBF improved in 11 children and, in the remaining 10 cases, the pattern was normal.
- In a group of four children with headache one year after brain concussion, three of them still presented with impairment of blood flow.

Lemka et al., 2005

Management of Post-Concussive Symptoms: Headache

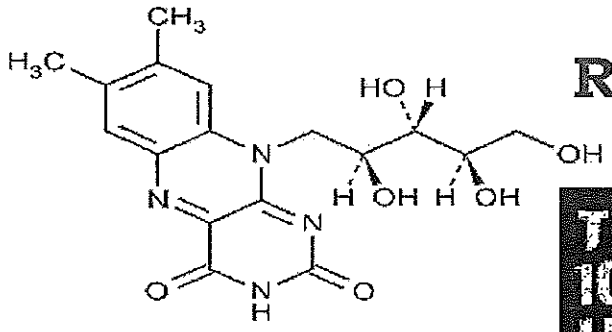
- The good news:



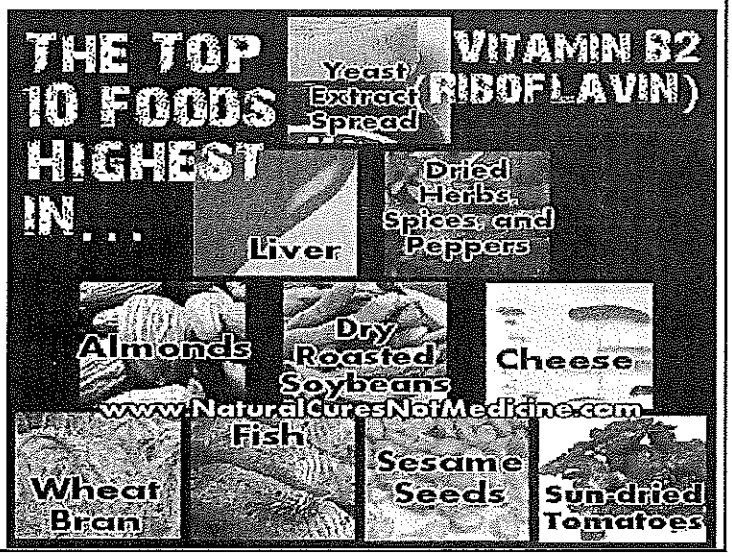
- Within six months, ~80% of patients with post-traumatic headache following head trauma show remission.
- And many patients respond to conventional headache management

Krusz, 2005
Solomon, 2001

Riboflavin (B2)



400mg/day



Complementary, Holistic, and Integrative Medicine: Butterbur

Introduction

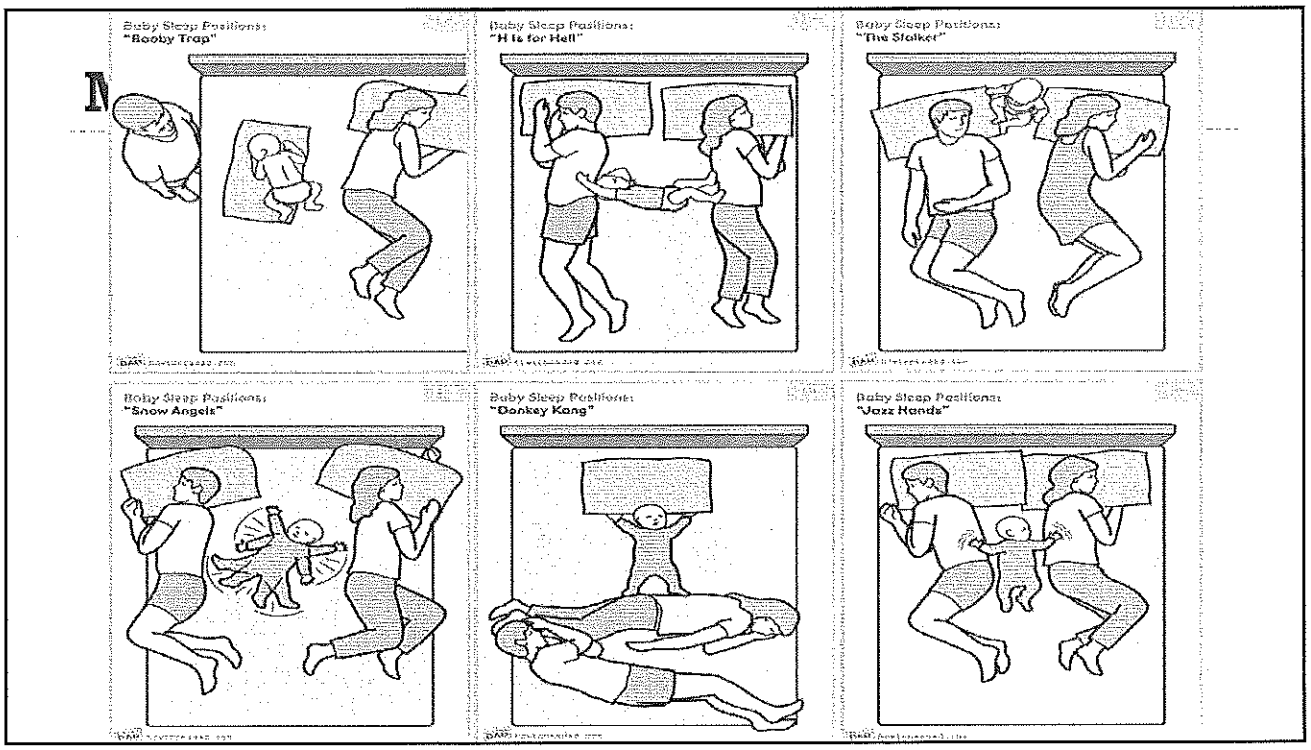
Petasites hybridus, a perennial shrub that grows in Europe, Asia, and North America, is commonly referred to as butterbur because the leaves of the plant have been used to wrap butter during warm seasons. (1)(2). Historically, butterbur has been used for a wide range of conditions, such as "urinary tract spasms," back pain, asthma, and topical wound healing. (3)(4) Generally, bitter-tasting compounds extracted from the root of the butterbur plant, known as petasins, are the active ingredient. (4)

Definition and Description

Butterbur is a member of the *Asteraceae/Compositae* family and has been used medicinally for more than 2,000 years. (2) Recent research has evaluated butterbur to prevent asthma attacks, allergic rhinitis, and migraine headaches due to its anti-inflammatory and antispasmodic effects. (3)(5)(6)(7)(8)(9)(10)(11)(12)(13)

Evidence of Efficacy in Pediatrics

Evidence for the use of butterbur in children is promising, although preliminary. Data are based primarily on open-label, cohort-controlled trials in adults and children and randomized, controlled trials (RCTs) in adults.



Management of Post-Concussive Symptoms: Sleep Disturbance

- 19 patients who had suffered TBI were investigated with polysomnography and were actigraphically monitored for five days at home. TBI was associated with lower sleep efficiency: 79.8 ± 9.8% vs 87.7 ± 6.8%; $P < 0.005$
- 44 consecutive patients were prospectively assessed with regard to CSF hypocretin-1 after acute TBI. Compared with controls, hypocretin-1 levels were abnormally lower in 95% of patients with moderate to severe TBI.

Kaufman et al., 2001
Baumann et al., 2005

Management of Post-Concussive Symptoms: Attention/Concentration

- Psychostimulants have been shown to improve recovery of motor function in animal trials if given before physical therapy.
- Stimulants and dopaminergic agonists such as bromocriptine and amantadine might help disorders of diminished motivation.
- Dextroamphetamine and methylphenidate may improve impulsivity, memory, and concentration in patients with TBI.

Feeney et al., 1982
Campbell & Duffy, 1997
Whyte et al., 2002

Disparities in Unmet Need for Care Coordination: The National Survey of Children's Health

"The need for care coordination and the lack of effective care coordination among those who needed it was higher among children with multiple conditions. Among children with >1 specific chronic condition, the percentage of children whose parents reported being in need of care coordination varied by condition from a low of 63% of children with asthma to a high of .....

(Pediatrics Vol. 131 No. 2 February 1, 2013)

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(Pediatrics Vol. 131 No. 2 February 1, 2013)

Reinforce the Team Approach

- Reinforce that the patient's family, medical team, coaches, and educators are all working together to get you back to normal.
- Educate family, coaches, and educators about concussion, the typical trajectory, and patient specific nuances.
- Talk with school about informal supports and/or a formal 504 Accommodation Plan.
  - Allow for missed assignments and "passes," as well as flexibility in schedule so the child does not fall too far behind or needs to be retained an academic year.
  - Don't try to catch up if the amount of work is insurmountable.
- Concussion should not result in an IEP under Traumatic Brain Injury or Other Health Impairment. If you are thinking there is still the need for special education, there were likely some pre-existing learning or mental health issue that have been amplified in light of the concussion.

BOSTON UNIVERSITY

Department of Veterans Affairs

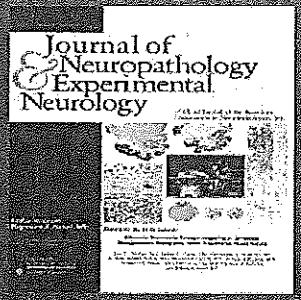
sportslegacy INSTITUTE

Chronic Traumatic Encephalopathy
or Dementia Pugilistica

First reported by Martland in 1928 in Boxers *Punch drunk, JAMA 91:1103-1107, 1928*

Martland described the spectrum of abnormalities found in "nearly one half of the fighters who have stayed in the game long enough"

In 2009, in the worlds literature: 51 cases of CTE including 3 cases from BU



Harrison S. Martland
(1883-1954)
First full time paid pathologist
Newark city Hospital
1909-1927
Chief Medical examiner Essex county

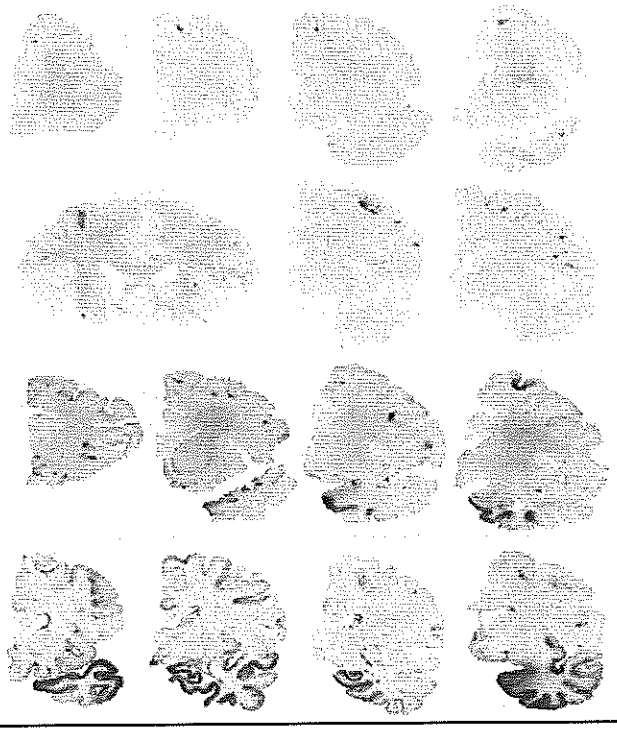
Chronic Traumatic Encephalopathy in Athletes: Progressive Tauopathy following Repetitive Head Injury.
McKee et al. J Neuropath Exp Neurol. 2009 68(7): 709-735

Stage I

Stage II

Stage III

Stage IV



http://www.bu.edu/cste/case-studies/

frontiers in
HUMAN NEUROSCIENCE

Absence of chronic traumatic encephalopathy in some retired football players with multiple concussions and neurological symptomatology

Lili-Naz Hazrati[1,2], Maria C. Tartaglia[2,3], Phedias Diamandis[1], Karen D. Davis[4,5,6,7], Robin E. Green[8], Richard Wennberg[3], Janice C. Wong[1,2], Leo Ezerins[9] and Charles H. Tator[4,7]*

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[4] Division of Neurosurgery, Krembil Neuroscience Centre, University Health Network, University of Toronto, Toronto, ON, Canada
[5] Division of Brain, Imaging, and Behaviour – Systems Neuroscience, Toronto Western Research Institute, University Health Network, Toronto, ON, Canada
[6] Department of Surgery, University of Toronto, Toronto, ON, Canada
[7] Institute of Medical Science, University of Toronto, Toronto, ON, Canada
[8] Research, Cognitive Neurorehabilitation Sciences Lab, Toronto Rehabilitation Institute, University of Toronto, Toronto, ON, Canada
[9] Executive Director, Canadian Football League Alumni Association, Members of the Canadian Sports Concussion Project at the Krembil Neuroscience Centre, Toronto Western Hospital and University of Toronto, Toronto, ON, Canada

This study only had an n=6