Mauricio A. Garcia-Barrera, PhD., R.Psych

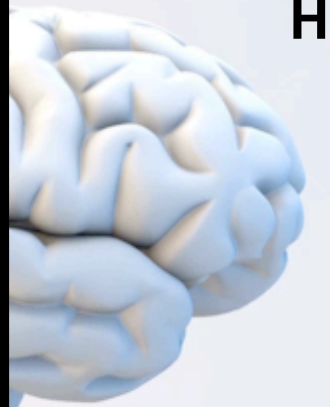
Stacey Horton

UVRA Elder Academy

Institute of Aging & Lifelong Health

CORTEX
A RESEARCH LAB FOR THE STUDY OF EXECUTIVE FUNCTIONS

University of Victoria



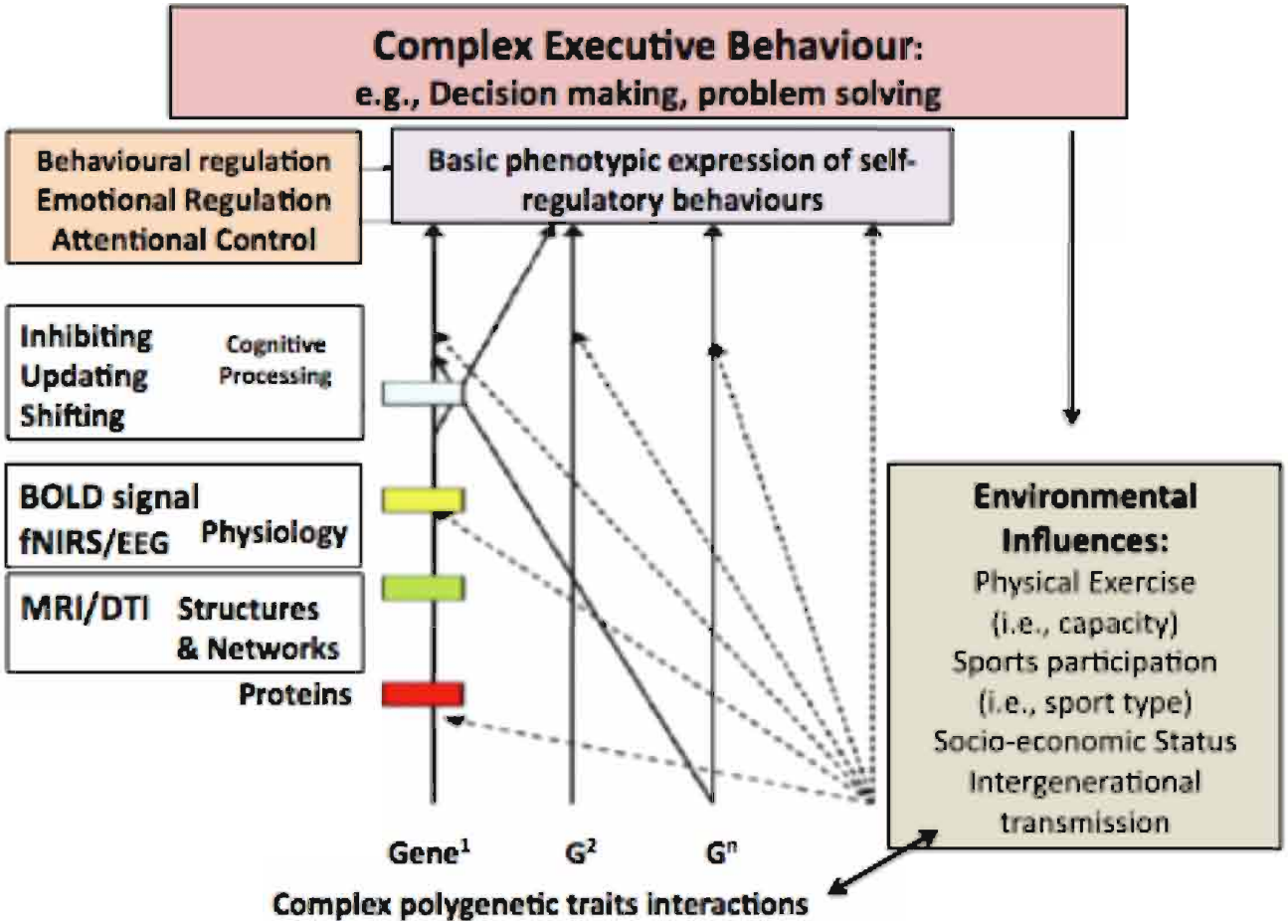
BUILDING BRAIN RESILIENCY AND HEALTHY AGING:

POSITIVE EFFECTS OF PHYSICAL ACTIVITY AND CONCUSSIONS IN THE AGING BRAIN

Land Acknowledgment

The land I enjoy: Traditional territories of the Lekwungen, the Songhees, Esquimalt and WSÁNEĆ Peoples.

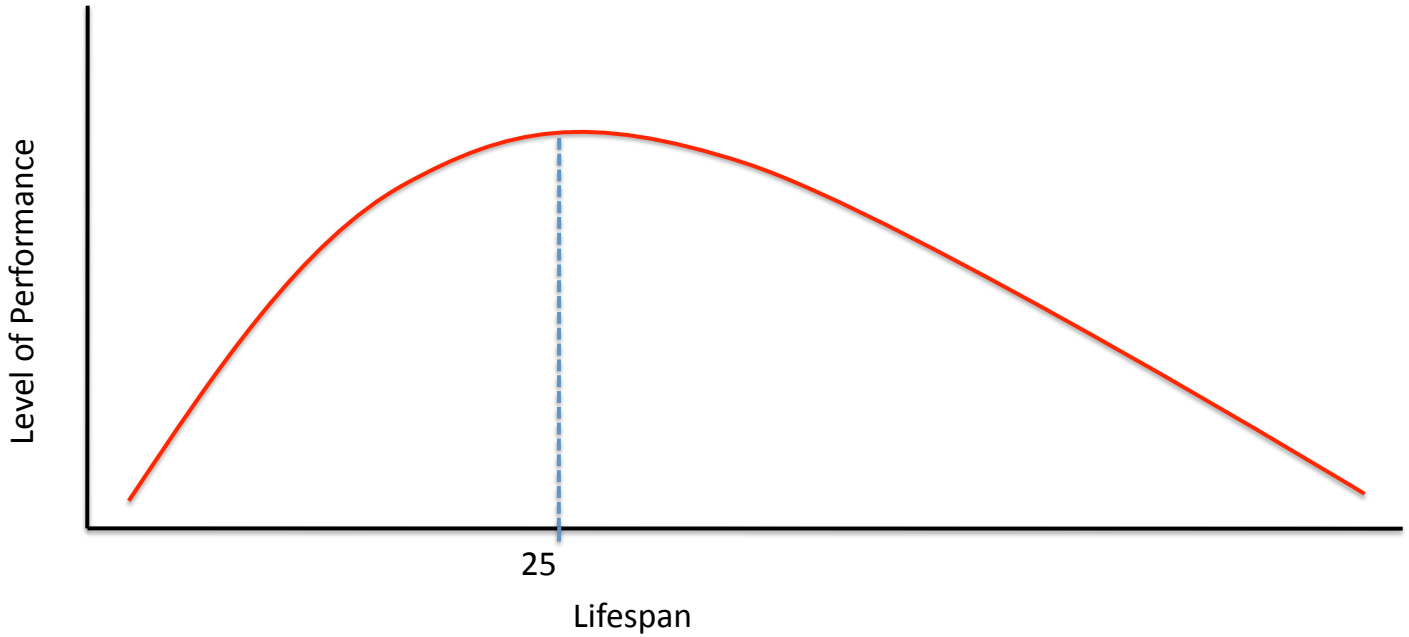
The land I come from: the Catías, Nutabes, Tahamíes, and the Quimbaya Indigenous Peoples.



Garcia-Barrera, in prep. Adapted from Crosbie et al, 2008

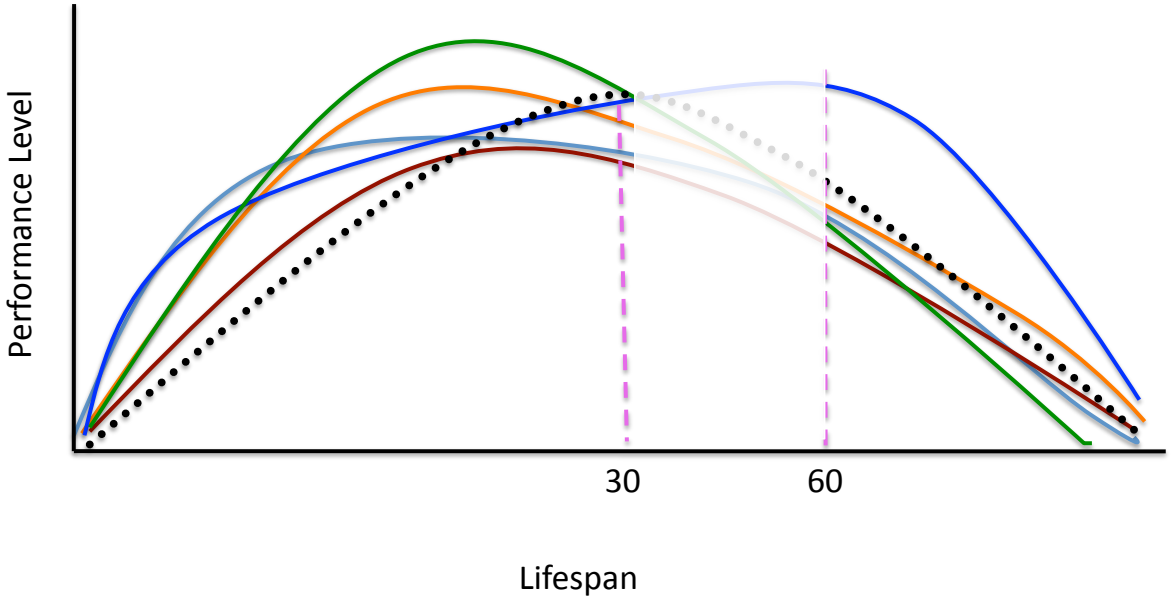
CORTEX

Cognitive Development: Inverted -U



CORTEX

Diverse developmental trajectories



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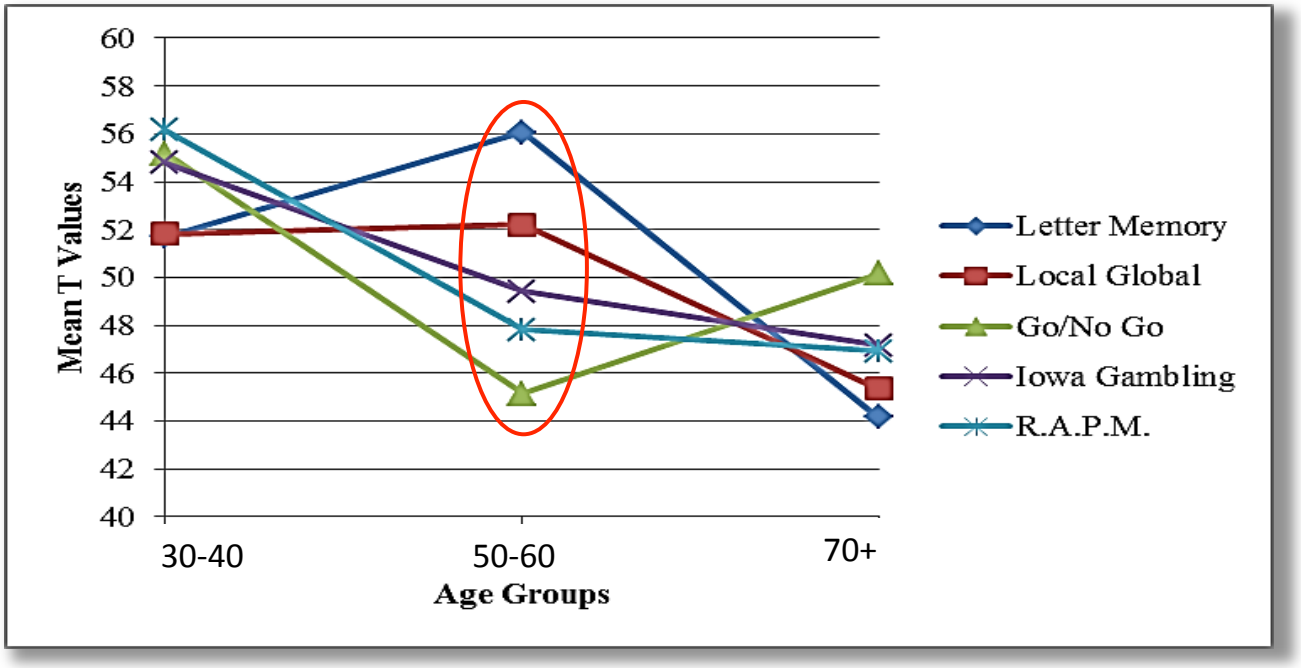
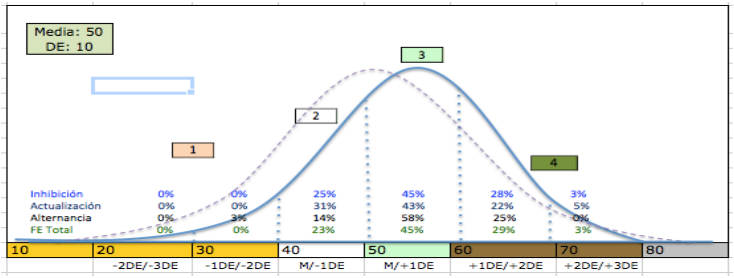
Larger within-group variability in middle adulthood:

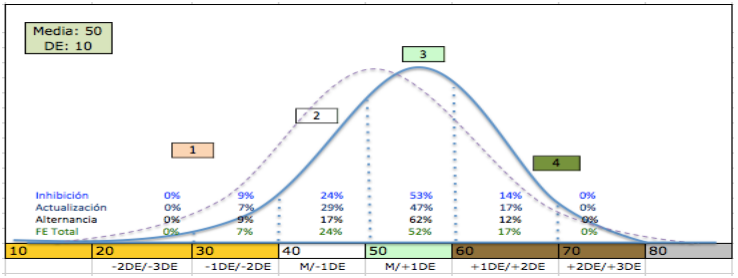


CORTEX

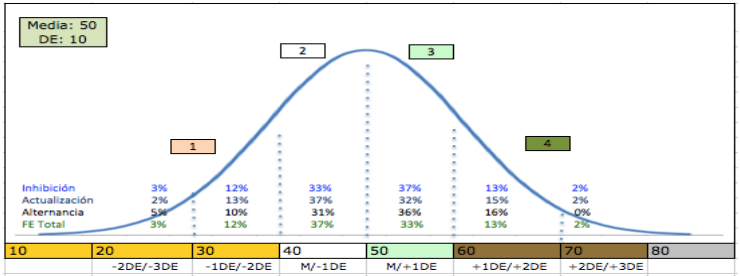
Master's Thesis
Emilie Crevier-Quintin



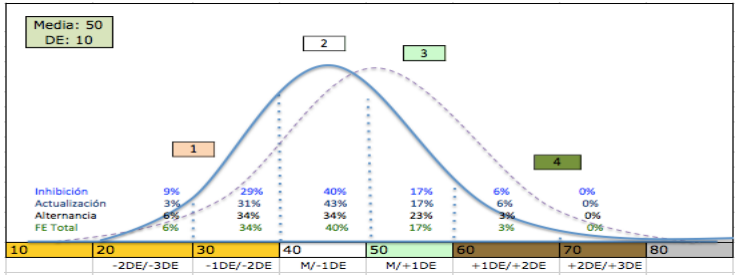
20-24 years



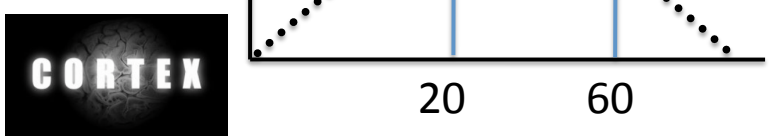
25-29 years

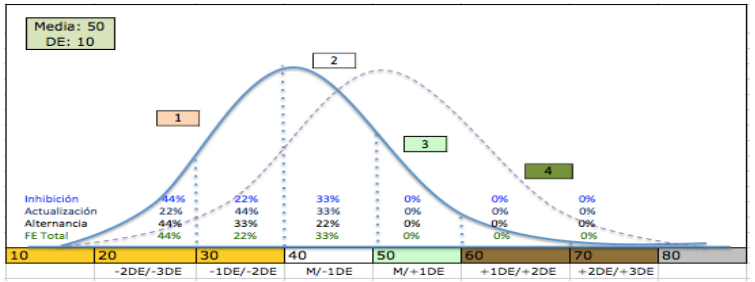


30-39 years



40-49 years





50-59 years

Protective factors

- Education
- Multilinguism
- Lifestyle:
  - Social networks and interactions
  - Nutrition
  - Cognitive stimulating activities
  - Physical activity

Neuropsychology
2014, Vol. 28, No. 6, 829–845

0894-4105/14/$12.00 http://dx.doi.org/10.1037/neu0000101

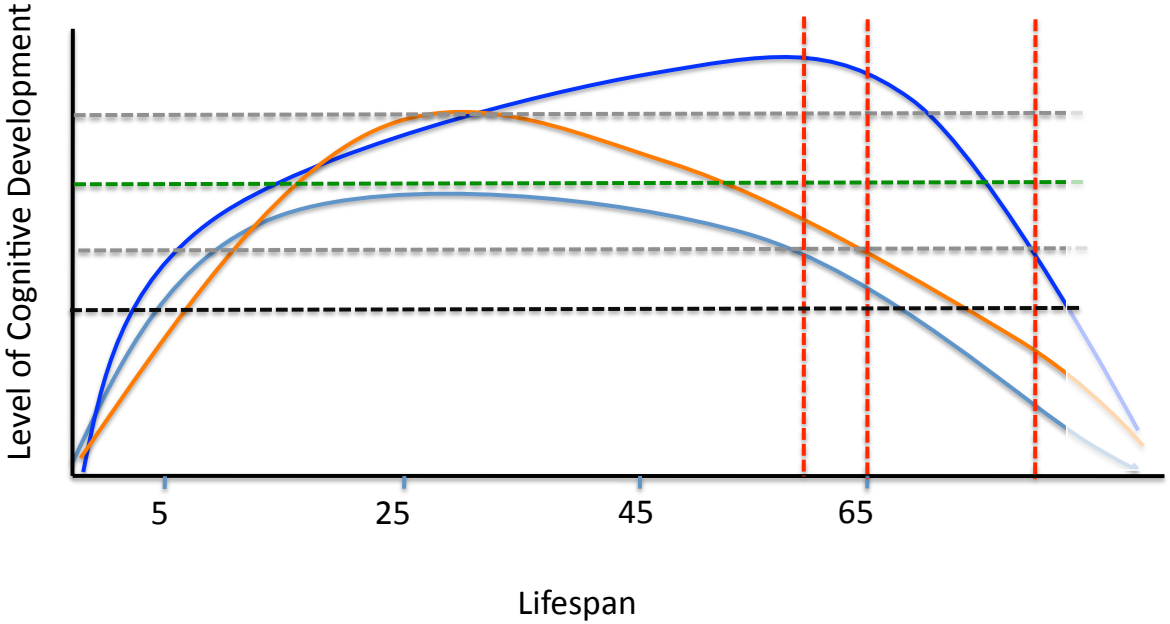
An Empirical Comparison of the Therapeutic Benefits of Physical Exercise and Cognitive Training on the Executive Functions of Older Adults: A Meta-Analysis of Controlled Trials

Justin E. Karr, Corson N. Areshenkoff, Philippe Rast, and Mauricio A. Garcia-Barrera
University of Victoria

Protective factors

- Education
- Multilinguism
- Lifestyle:
  - Social networks and interactions
  - Nutrition
  - Cognitive stimulating activities
  - Physical activity

Developmental Trajectories



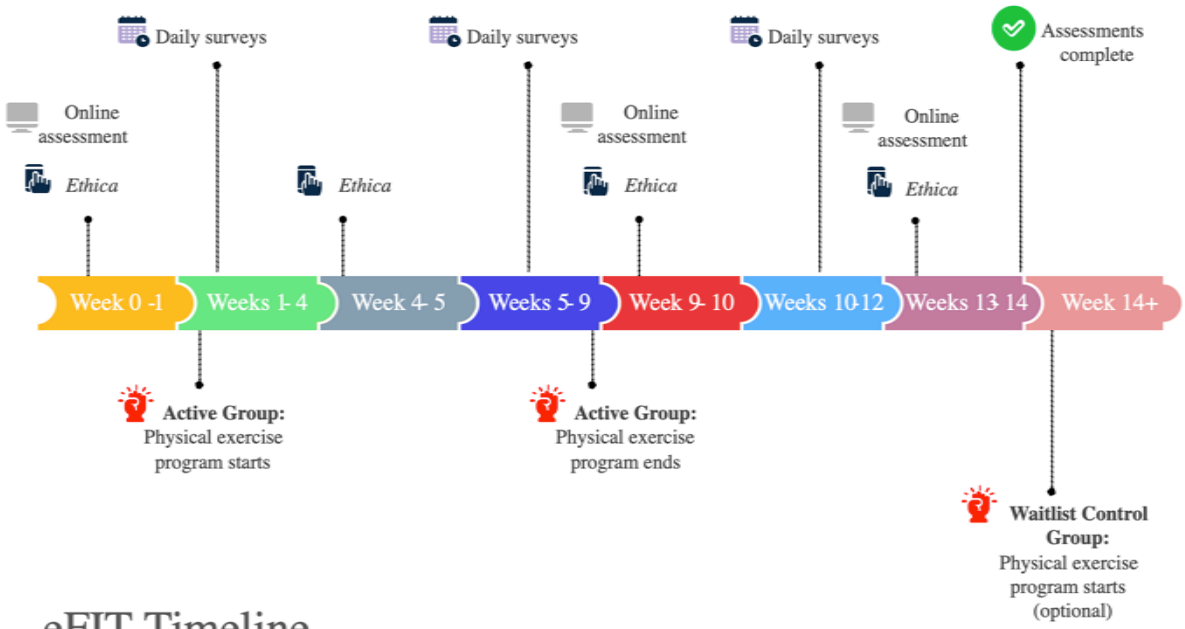
CORTEX

eFIT Study

Aimed at examining the effects of an 8-week physical activity training on executive functioning, mood, stress, fatigue and sleep, and their interactions.

- Multi-method assessment approach
- Multi-dimensional approach to executive functioning
- Randomized control design with a waitlist control group

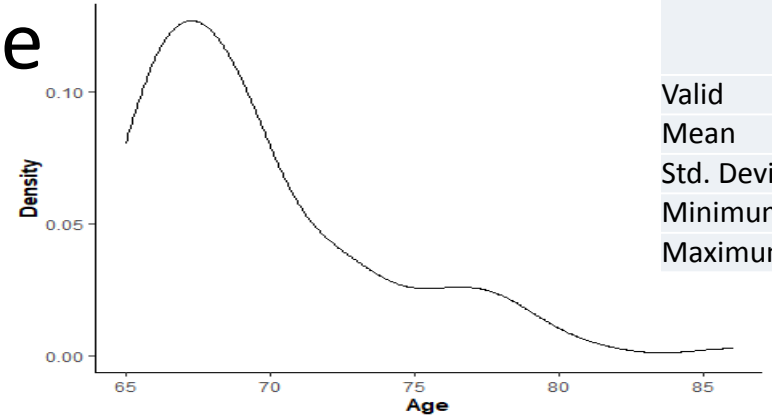
Executive Function Improvement Training Study (eFIT)



eFIT Timeline

The eFIT sample

- N= 104
- Age
- Ethnicity
  - 98% White,
  - 2% South Asian
- Location across Canada
- Gender
  - 74% female, 26 % male
- Education
  - 6% HS, 14% some college,
  - 50% University, Master's 23, PhD 4

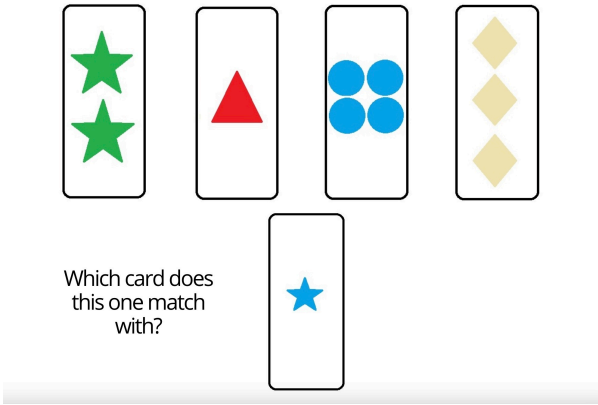


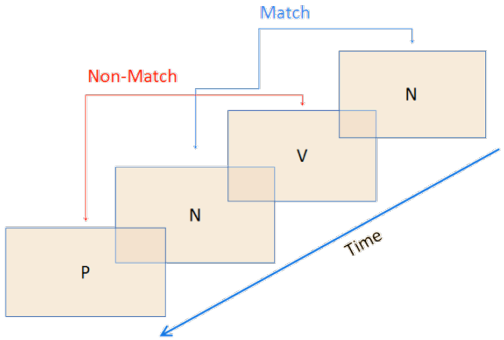
	Age	
	Active	Waitlist
Valid	60	44
Mean	69.43	69.73
Std. Deviation	4.35	4.04
Minimum	65.00	65.00
Maximum	81.00	86.00

Provinces	Percent
Nova Scotia	2.89
Alberta	2.89
British Columbia	69.23
Manitoba	1.92
New Brunswick	0.96
Ontario	15.39
Prince Edward Island	1.92
Quebec	2.89
Yukon	1.92
Missing	0.00
Total	100.00

ASSESSMENT:

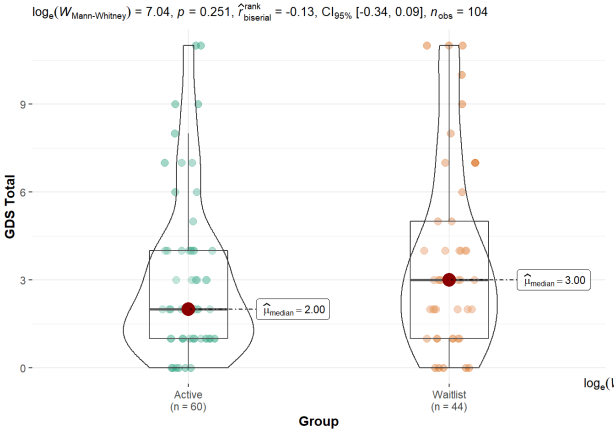
- Questionnaires (Depression, anxiety, PA)
- 13 computerized tasks (Executive function, memory, attention)
- Ecological Momentary Assessment daily survey (burst design)

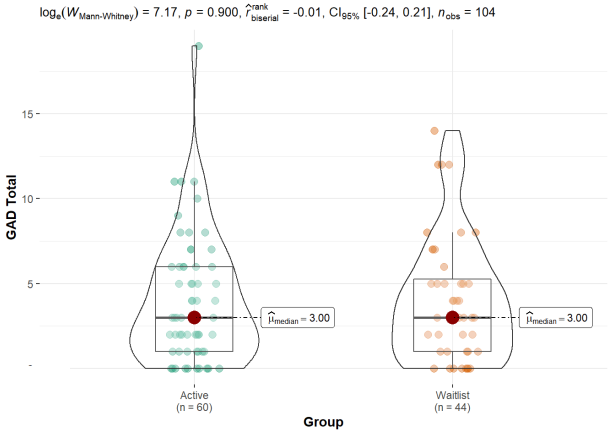


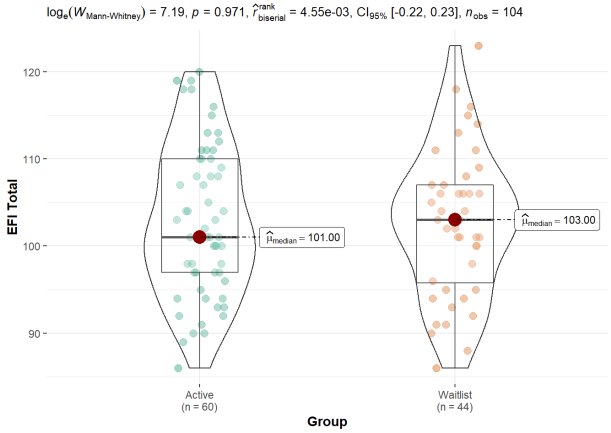


CORTEX

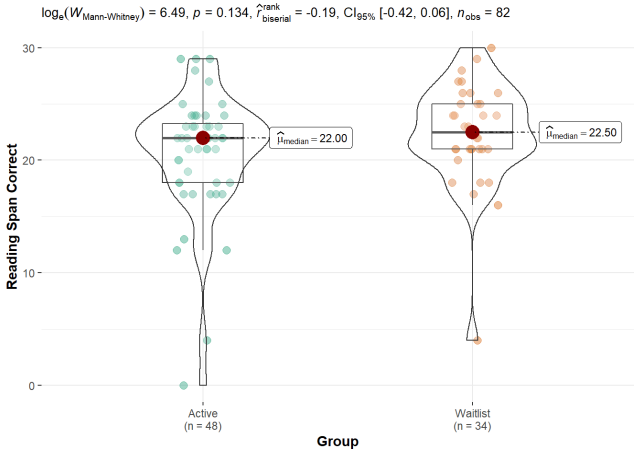
RESULTS
Between – Groups (PRE)

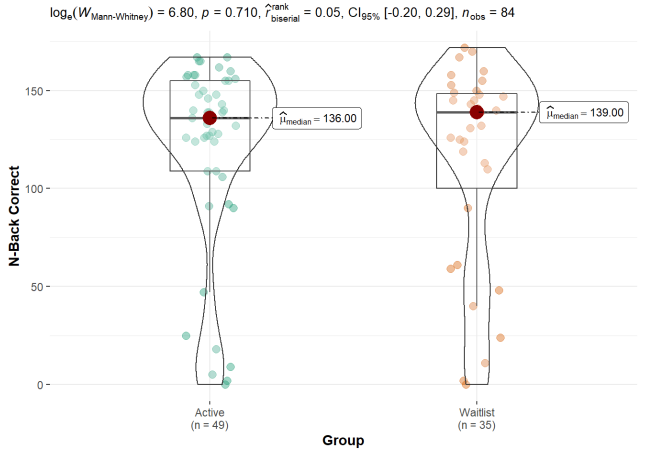


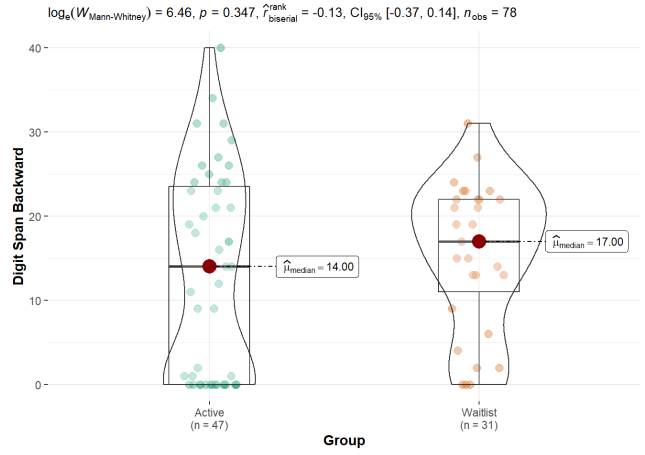


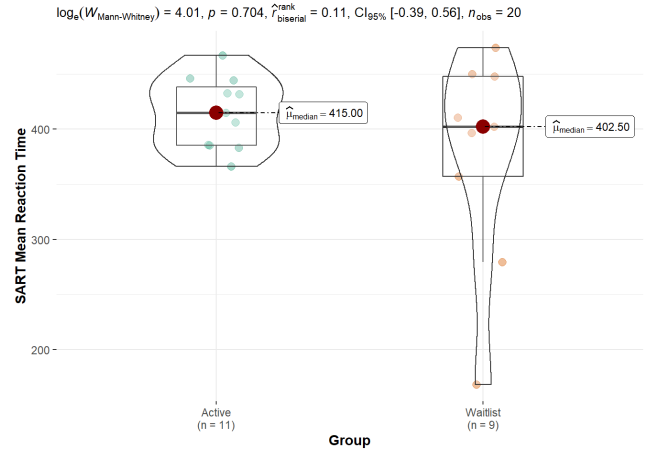


RESULTS Between – Groups (PRE)

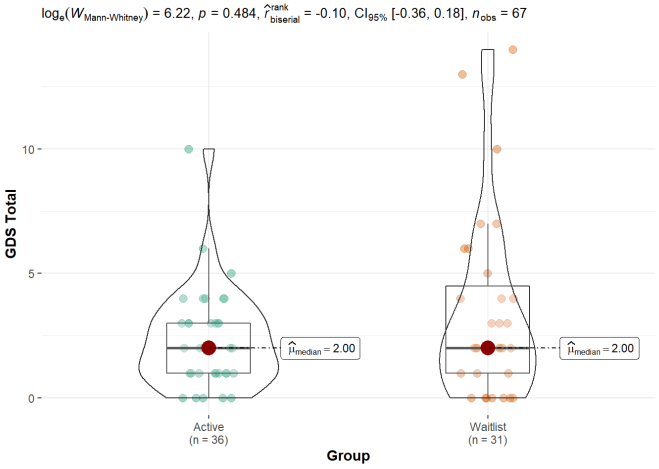


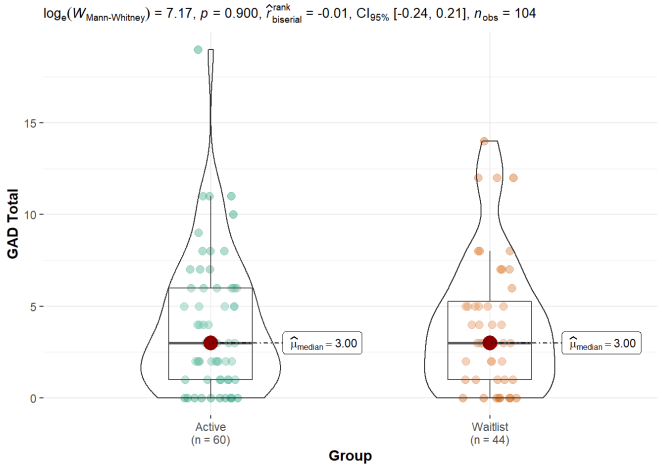


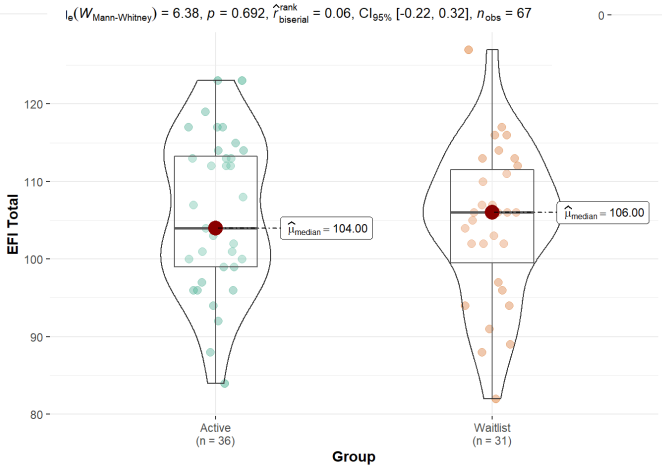




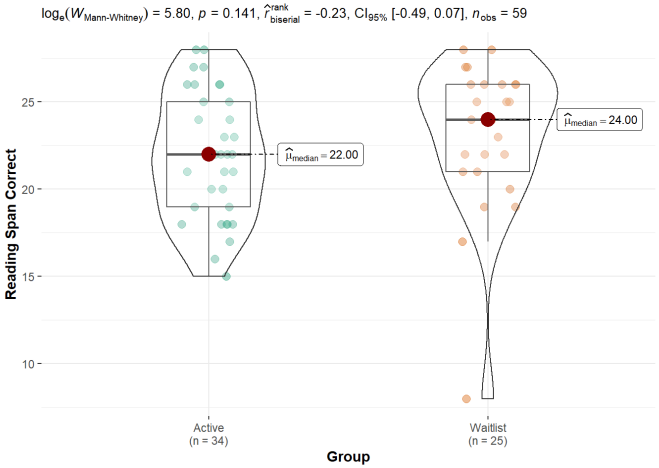
RESULTS
Between – Groups (POST)

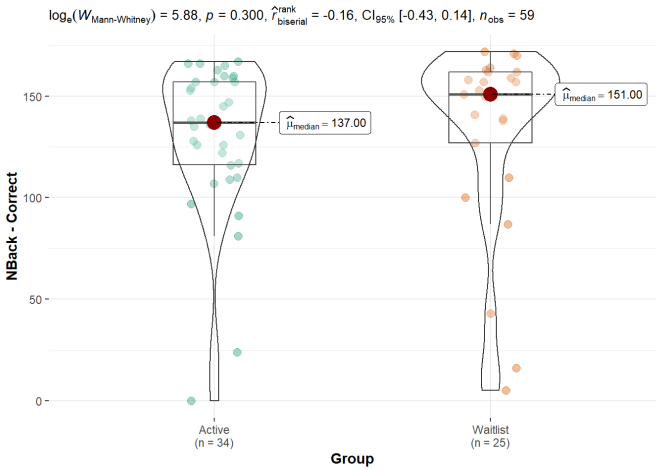


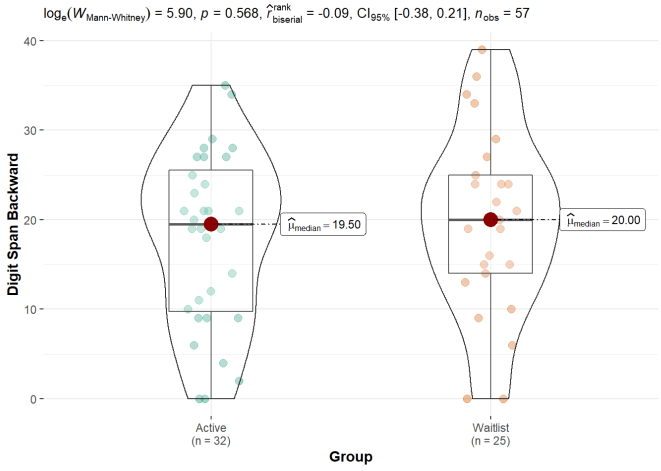


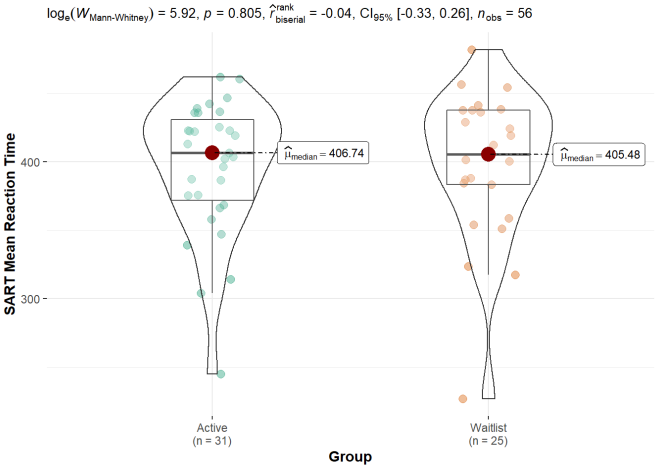


RESULTS Between – Groups (POST)









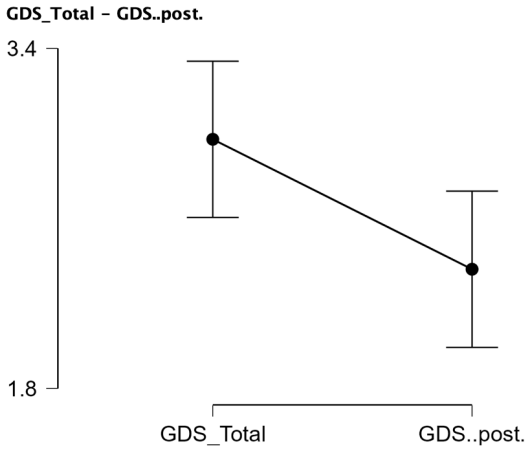
RESULTS
Within – Active Group

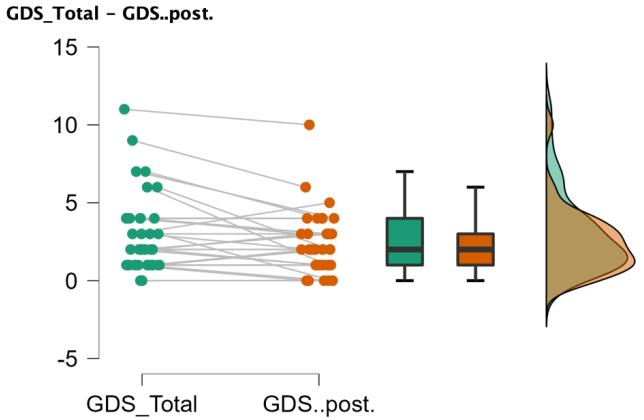
GDS

Paired Samples T-Test

Measure 1		Measure 2	W	z	df	p	Rank-Biserial Correlation	95% CI for Rank-Biserial Correlation	
								Lower	Upper
GDS_Total	-	GDS..post.	189.000	2.029		0.036	0.494	0.064	0.769

Note. Wilcoxon signed-rank test.





RESULTS
Within – Active Group

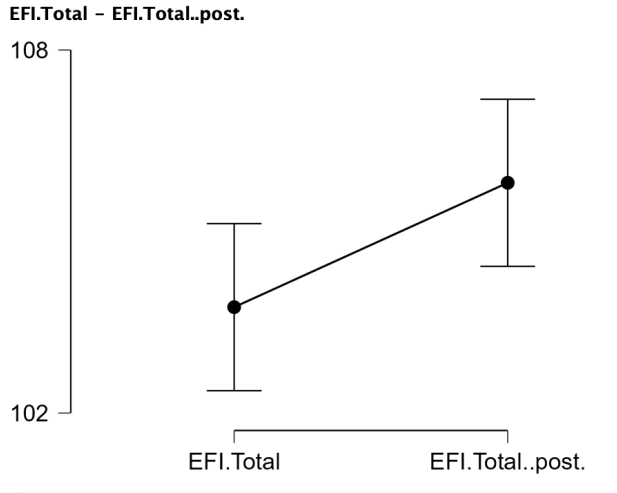
EFI

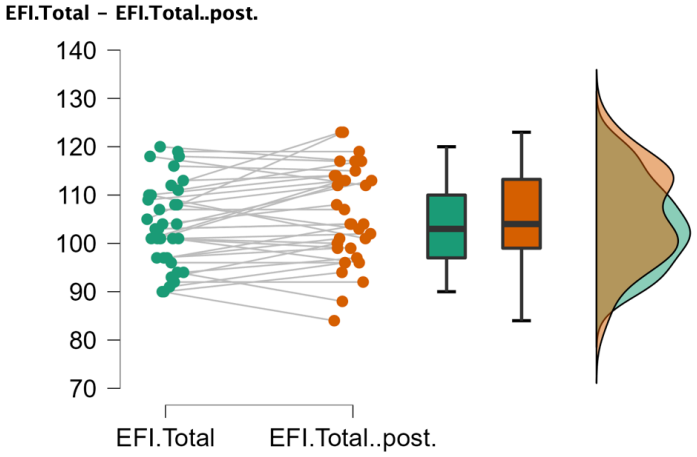
Paired Samples T-Test

Measure 1		Measure 2	t	df	p	Cohen's d	95% CI for Cohen's d	
							Lower	Upper
EFI.Total	-	EFI.Total..post.	-2.137	35	0.040	-0.356	-0.691	-0.017

Note. Student's t-test.

Empathy
Impulse Control*
Organization*
Motivational Drive
Strategic Planning





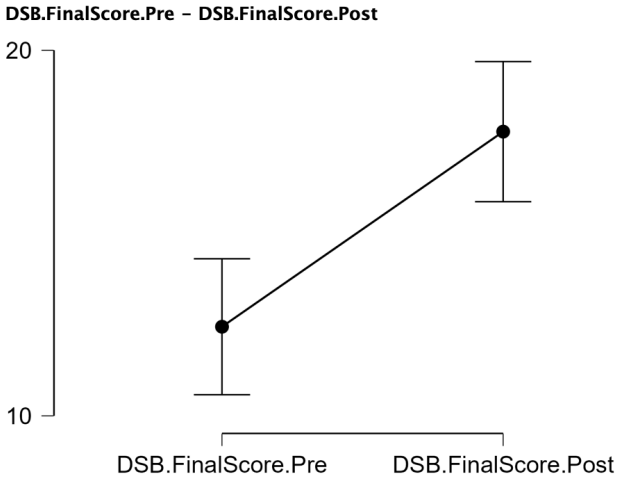
RESULTS
Within – Active Group

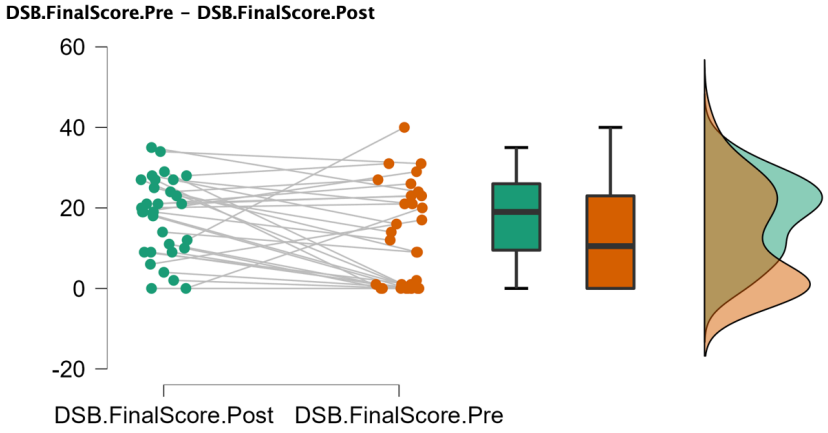
Digit Span Backward

Paired Samples T-Test

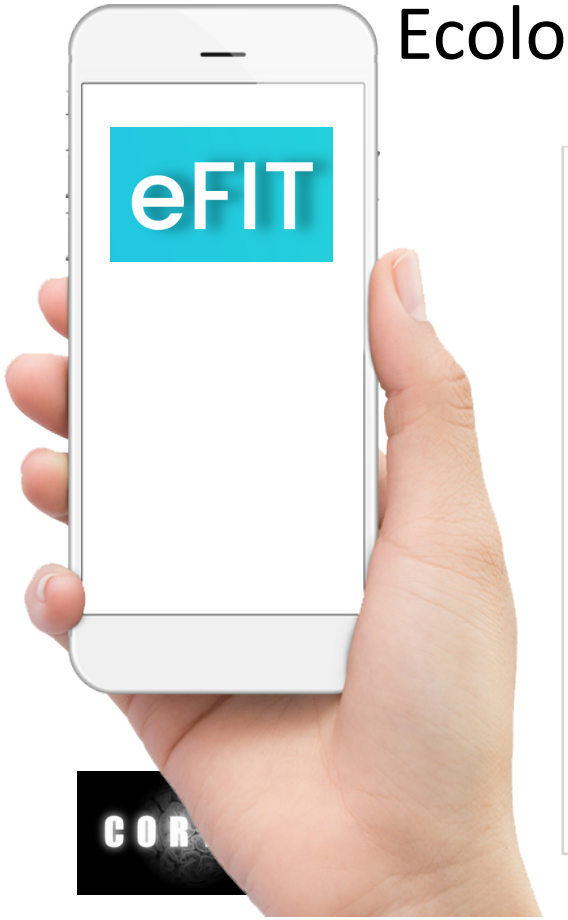
								95% CI for Rank-Biserial Correlation	
Measure 1		Measure 2	W	z	df	p	Rank-Biserial Correlation	Lower	Upper
DSB.FinalScore.Pre	-	DSB.FinalScore.Post	54.000	-2.555		0.011	-0.609	-0.825	-0.235

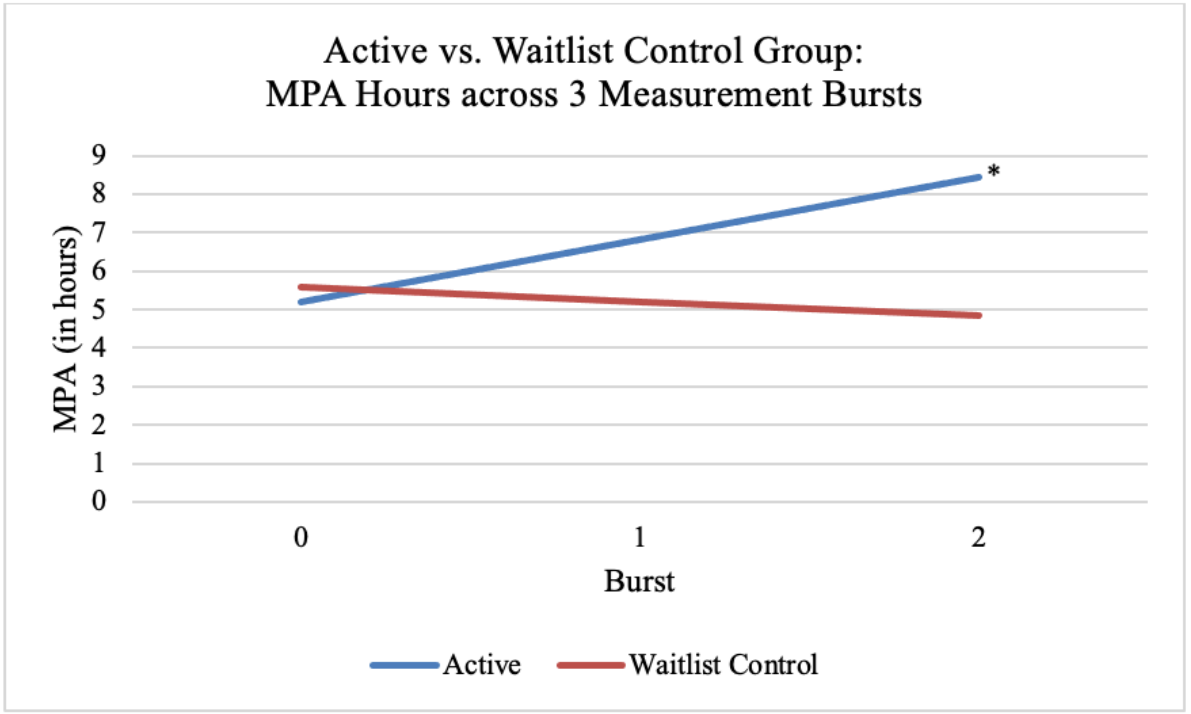
Note. Wilcoxon signed-rank test.





PRELIMINARY RESULTS
Ecological Momentary Assessment





CORTEX


concussion
emergency
victim
male
skull
disease
childhood
neurology
patient
medicine
magnetic
face bruise
stethoscope
broken
injured
scientific
technology
doctor
grief
resonance
mri
injury
tired
bandage
person
medical
head
pain
syndrome
body
human
result
protection aid
loss
prognosis
surgery
brain
science
depression
prevention
hand
diagnosis
radiology
anatomy
bleeding
recovery
procedure
blood
sport
scan
serious
illness
health
emotional
headache
writing
mental
exhaustion
treatment
trauma
accident
healthcare
despair
wound
physical
whistle

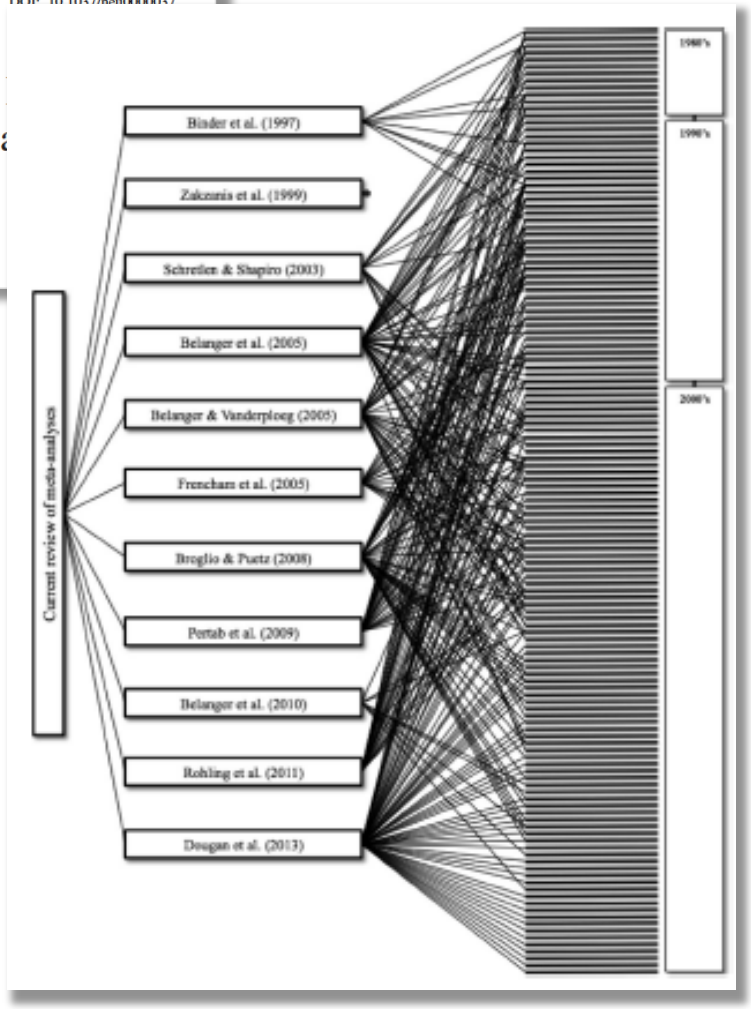
CORTEX

Neuropsychology

0894-4105/13/$12.00 DOI: 10.1037/neu0000037

The Neuropsychological Outcomes of Concussion: A Systematic Meta-Analyses on the Cognitive Sequelae of Mild Traumatic Bra

Justin E. Karr, Corson N. Areshenkoff, and Mauricio A. Garcia-Barrera
University of Victoria



- Comparison of effect sizes based on moderators
- Relevant moderators:
  - Time Since Injury
  - Participant Characteristics
  - Cognitive Domain
  - Cumulative Effect

CORTEX

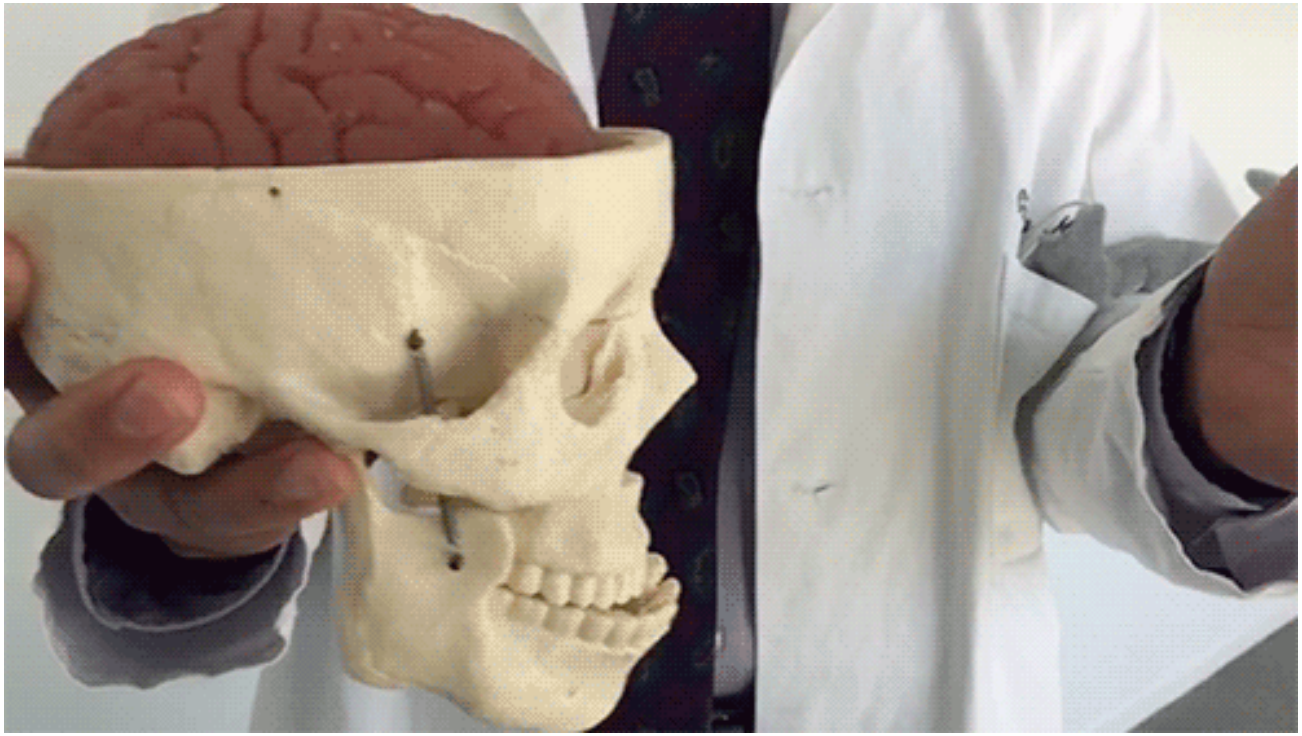
Results

- Cognitive domain
  - highly variable
  - global abilities, orientation, attention, working memory, executive functioning, fluency, memory, visuospatial skills, verbal comprehension, processing speed, motor
- Time since injury
  - Most athletes recover within 7 to 14 days
- Worse outcomes
  - Younger
  - Less Educated
  - Female

- Effects on Cognition

Executive Functioning is most sensitive to multiple mTBI

Sports-Related Concussions (SRC)



CORTEX

Updates to the definition of SRC:

Doesn’t necessarily involve head impact

Doesn’t necessarily involve LOC

CORTEX

- Recognise
- Remove
- Re-evaluate
- Rest
- Rehabilitation
- Refer

- Recovery*
- Return to sport
- Reconsider
- Residual effects and sequelae
- Risk reduction

CORTEX

CORTEX

BRAIN INJURY

http://informahealthcare.com/bij
ISSN: 0269-9052 (print), 1362-301X (electronic)

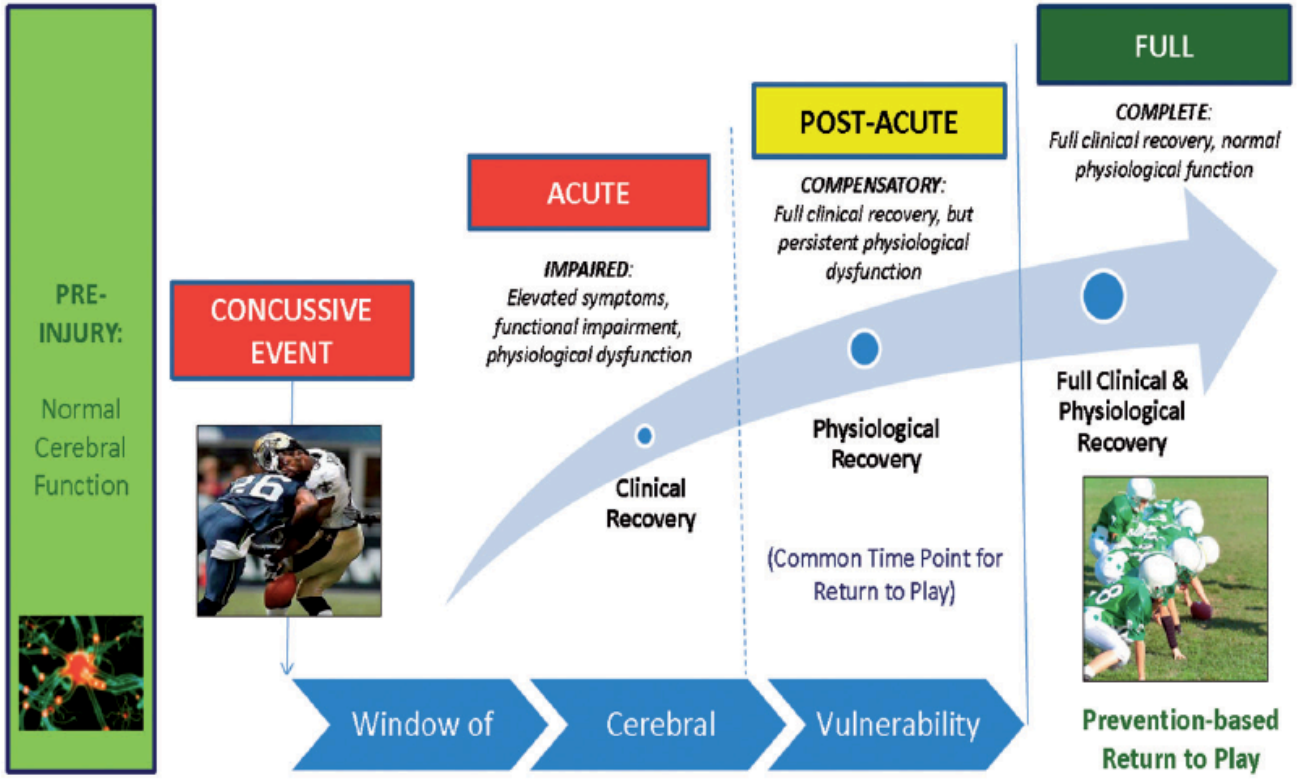
Brain Inj, 2015; 29(2): 276–282
© 2015 Informa UK Ltd. DOI: 10.3109/02699052.2014.965216

informa healthcare

REVIEW

Sports concussion assessment and management: Future research directions

Michael McCrea[1,2], Donna K. Broshek[3], & Jeffrey T. Barth[3]



CORTEX

7-14 days for adults, 4 weeks for children

- Recognise
- Remove
- Re-evaluate
- Rest
- Rehabilitation
- Refer

- Recovery
- Return to sport*
- Reconsider
- Residual effects and sequelae
- Risk reduction

CORTEX

CORTEX

Return to Sport

This tool is a guideline for managing an individual's return to sport following a concussion and does not replace medical advice. Timelines and activities may vary by direction of a health care professional.

STAGE 1:	STAGE 2:	STAGE 3:	STAGE 4:	STAGE 5:	STAGE 6:
No sporting activity Physical and cognitive rest until symptoms start to improve OR after resting for 2 days max.	**Light aerobic exercise** Walking, swimming, stationary cycling. No resistance training. The pace of these activities should be at the point where you are still able to have a conversation.	**Sport-specific exercise** Skating drills (ice hockey), running drills (soccer). No head-impact activities.	**Non-contact drills** Progress to complex training drills (e.g. passing drills). May start resistance training.	**Full-contact practice** Following medical clearance participate in normal training activities.	**Back in the game** Normal game play
Recovery	Increase heart rate	Add movement	Exercise, coordination, cognitive load	Restore confidence; assess functional skills	
Symptoms improve or 2 days rest max? **Yes:** Move to stage 2 **No:** Continue resting Time & Date completed:	**No new or worsening symptoms for 24 hours?** **Yes:** Move to stage 3 **No:** Return to stage 1 Time & Date completed:	**No new or worsening symptoms for 24 hours?** **Yes:** Move to stage 4 **No:** Return to stage 2 Time & Date completed:	**Symptom-free for 24 hours?** **Yes:** Move to stage 5 **No:** Return to stage 3 Time & Date completed:	**Symptom-free for 24 hours?** **Yes:** Move to stage 6 **No:** Return to stage 4 Time & Date completed:	**Note: Premature return to contact sports (full practice and game play) may cause a significant setback in recovery.**

If new or worsening symptoms are experienced at any stage, go back to the previous stage for at least 24 hours. You many need to move back a stage more than once during the recovery process.

Medical clearance required before moving to stage 5

BOTH TOOLS CAN BE USED IN PARALLEL; HOWEVER, RETURN TO SCHOOL SHOULD BE COMPLETED BEFORE RETURN TO SPORT IS COMPLETED

CORT www.cattonline.com

CATT | CONCUSSION AWARENESS TRAINING TOOL

BC INJURY research and prevention unit

Return-to-Sport Strategies

Wrestling Return-to-Sport Strategy	PDF/UA
Water Polo Return-to-Sport Strategy	PDF/UA
Volleyball Return-to-Sport Strategy	PDF/UA
Soccer Return-to-Sport Strategy	PDF/UA
Ski Jumping Return-to-Sport Strategy	PDF/UA
Sailing Return-to-Sport Strategy	PDF/UA
Rugby Return-to-Sport Strategy	PDF/UA
Nordic Return-to-Sport Strategy	PDF/UA
Judo Return-to-Sport Strategy	PDF/UA
Hockey Return-to-Sport Strategy	PDF/UA +
Freestyle Ski Return-to-Sport Strategy	PDF/UA
Field Hockey Return-to-Sport Strategy	PDF/UA
Equestrian Return-to-Sport Strategy	PDF/UA
Curling Return-to-Sport Strategy	PDF/UA
Cross-country Ski Return-to-Sport Strategy	PDF/UA
Canoe and Kayak Return-to-Sport Strategy	PDF/UA

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Return to School

This tool is a guideline for managing a student's return to school following a concussion and does not replace medical advice. Timelines and activities may vary by direction of a health care professional.

AT HOME

STAGE 1:

Physical & cognitive rest

- Basic board games, crafts, talk on phone
- Activities that do not increase your heart rate or cause you to break a sweat

Limit/Avoid:

- Computer, TV, texting, video games, reading

No:

- School work
- Sports
- Work
- Driving until cleared by a health care professional

Rest

When symptoms start to improve OR after resting for 2 days max, BEGIN STAGE 2

STAGE 2:

Start with light cognitive activity:

Gradually increase cognitive activity up to 30 min. Take frequent breaks.

Prior activities plus:

- Reading, TV, drawing
- Limited peer contact and social networking

Contact school to create *Return to School* plan.

When light cognitive activity is tolerated:

Introduce school work.

Prior activities plus:

- School work as per *Return to School* plan

Communicate with school on student's progression.

No:

- School attendance
- Sports
- Work

Gradually add cognitive activity including school work at home

Tolerates 30 min. of cognitive activity, introduce school work at home

Tolerates 60 min. of school work in two 30 min. intervals, BEGIN STAGE 3

AT SCHOOL

STAGE 3:

Back to school part-time

Part-time school with maximum accommodations.

Prior activities plus:

- School work at school as per *Return to School* plan

No:

- P.E., physical activity at lunch/recess, homework, testing, sports, assemblies, field trips

Communicate with school on student's progression.

School work only at school

Tolerates 120 min. of cognitive activity in 30-45 min. intervals, BEGIN STAGE 4

STAGE 4:

Part-time school

Increase school time with moderate accommodations.

Prior activities plus:

- Increase time at school
- Decrease accommodations
- Homework – up to 30 min./day
- Classroom testing with adaptations

No:

- P.E., physical activity at lunch/recess, sports, standardized testing

Communicate with school on student's progression.

Increase school work, introduce homework, decrease learning accommodations

Tolerates 240 min. of cognitive activity in 45-60 min. intervals, BEGIN STAGE 5

STAGE 5:

Full-time school

Full days at school, minimal accommodations.

Prior activities plus:

- Start to eliminate accommodations
- Increase homework to 60 min./day
- Limit routine testing to one test per day with adaptations

No:

- P.E., physical activity at lunch/recess, sports, standardized testing

Work up to full days at school, minimal learning accommodations

Tolerates school full-time with no learning accommodations BEGIN STAGE 6

STAGE 6:

Full-time school

Full days at school, no learning accommodations.

Prior activities plus:

- Attend all classes
- All homework
- Full extracurricular involvement
- All testing

No:

- full participation in P.E. or sports until *Return to Sport* protocol completed and written medical clearance provided

Full academic load

Return to School protocol completed; focus on *RETURN TO SPORT*

Note: A student is tolerating an activity if symptoms are not exacerbated.

Adapted from the Return to Learn protocol by G.F. Strong School Program (Vancouver School Board), Adolescent and Young Adult Program, G.F. Strong Rehabilitation Centre.

www.cattonline.com

CATT | CONCUSSION AWARENESS TRAINING TOOL

BC INJURY research and prevention unit

Return to Work

This tool is a guideline for managing an individual's return to work following a concussion and does not replace medical advice. The goal for each stage is to find the 'sweet spot' between doing too much and doing too little. Timelines and activities may vary by direction of a health care professional.

AT HOME

STAGE 1:

Initial physical and cognitive rest

- Rest in a quiet and calm environment.
- Try activities that do not aggravate symptoms (e.g., listening to quiet music or colouring).
- Sleep as much as your body needs while trying to maintain a regular night sleeping schedule.

Limit:

- Lengthy social visits.
- Screen time (smartphone, computer, television) and reading.

Avoid:

- Sports or physical activities that increase your heart rate or cause you to break a sweat.

NOTE: It is recommended to discuss driving with a licensed medical professional for safety considerations.

Rest

When symptoms start to improve OR after resting for 2 days max,
BEGIN STAGE 2

STAGE 2:

Light activity

- Gradually increase cognitive activity by trying simple, familiar tasks (e.g., reading, watching TV, using the computer or drawing).
- Go for walks or try other light physical activity (e.g., swimming, stationary bike, light housework), without becoming short of breath.
- Take frequent rest periods; keep napping to a minimum.
- Begin with brief periods of activity, up to 30 minutes.
- Start thinking about returning to work: communicating with the workplace, a return to work plan, and your commute.

Gradually increase activity

When 30 minutes of activity is tolerated,
BEGIN STAGE 3

STAGE 3:

Prepare to return to work—at home

- Continue to increase cognitive activity.
- Continue to return to pre-injury physical activities (e.g., grocery shopping, gardening, jogging, light weight training).
- Contact workplace to discuss a tailored Return to Work plan.
- Attempt to commute to work to assess if it aggravates symptoms or drains energy.
- A regular sleeping schedule supports a successful return to work.
- Work your way up to 2 hours of activity, with breaks as needed.

Prepare to return to work—at work

- Work accommodations can include: flexible hours, reduced workload, extra time for tasks, access to a quiet, distraction-free work environment.
- Arrange to return to work on a graduated basis. Consider number of hours per day and appropriate accommodations.
- Work your way up to an additional 2 hours of activity, with breaks as needed.
- Have a plan to leave work and return to Stage 2 if symptoms worsen.

Prepare to return to work

When 4 hours of activity is tolerated, with breaks as needed,
BEGIN STAGE 4

AT WORK

STAGE 4:

Begin graduated return to work

- Return to work according to your graduated return to work plan, with the agreed upon number of hours per day and accommodations.
- At work, start with less demanding activities before more difficult ones.
- Gradually increase working hours week-to-week, or sooner, as appropriate.

Return to work with accommodations and a personalized *Return to Work* plan

When ready for regular work hours with accommodations,
BEGIN STAGE 5

STAGE 5:

Regular work hours with modifications, as needed

- Decrease accommodations as energy and capacity increases.
- Accommodations can be phased out in "trial" periods, to ensure that they are no longer needed.
- Monitor energy levels for completing household tasks and participating in social or recreational activities after the work day.

Adjust workplace accommodations, as needed

When regular work hours are tolerated with min. accommodations,
BEGIN STAGE 6

STAGE 6:

Full return to work

- Full regular work schedule with usual expectations for productivity, without accommodations.

NOTE: Only return to job duties that may have safety implications for you or others when cleared by a licensed medical professional (e.g., operating heavy equipment, working from heights, driving).

Full return to work

Once you have **COMPLETED STAGE 6,** *Return to Work* strategy completed

Recognizing that workplace environments vary by industry and occupation, returning to work may focus more on a return to cognitive activity, physical activity, or a combination of both. It is normal to experience symptoms during recovery; you do not have to wait to be symptom free before returning to work. However, after Stage 2, if new or worsening symptoms appear at any stage, go back to the previous stage for at least 24 hours. You many need to move back a stage more than once during the recovery process.

CORTE

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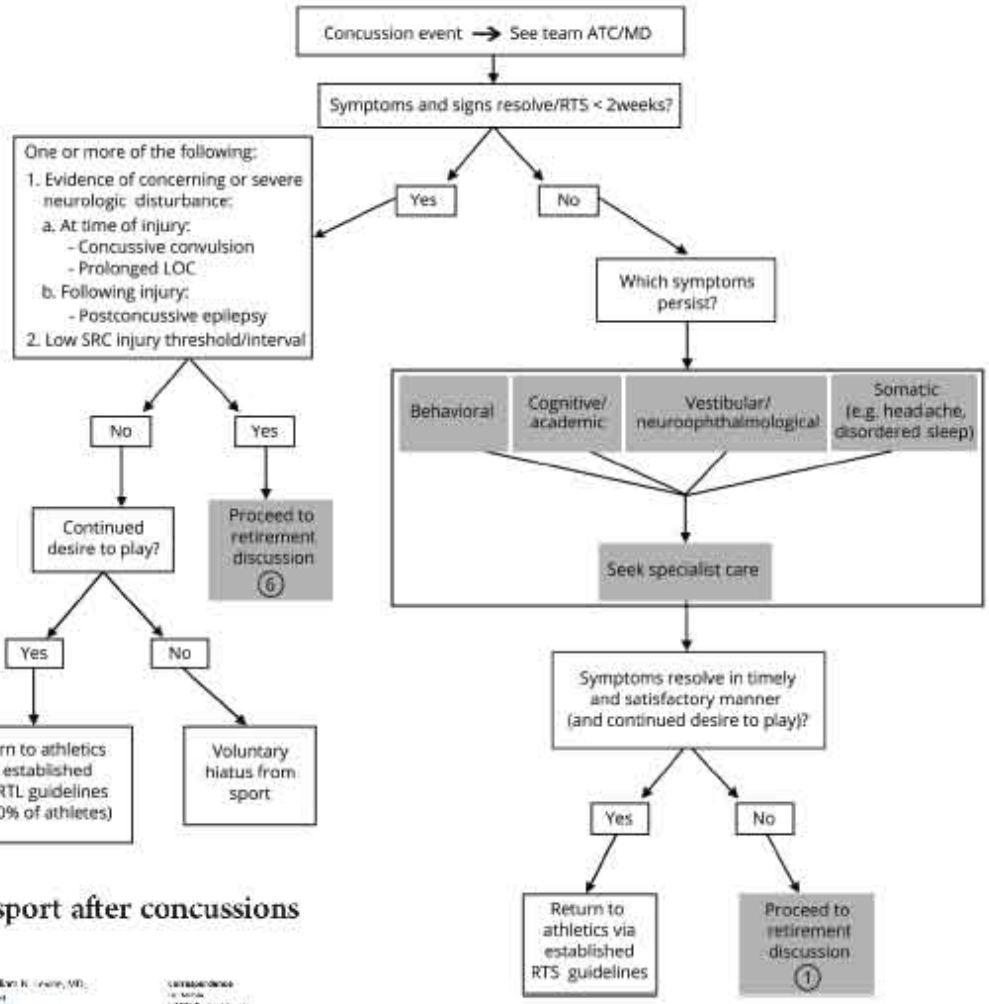
BC INJURY research and prevention unit
www.injuryresearch.bc.ca

Silverberg ND, Iverson GL (2013). doi: 10.1097/HTR.0b013e31825ad658.

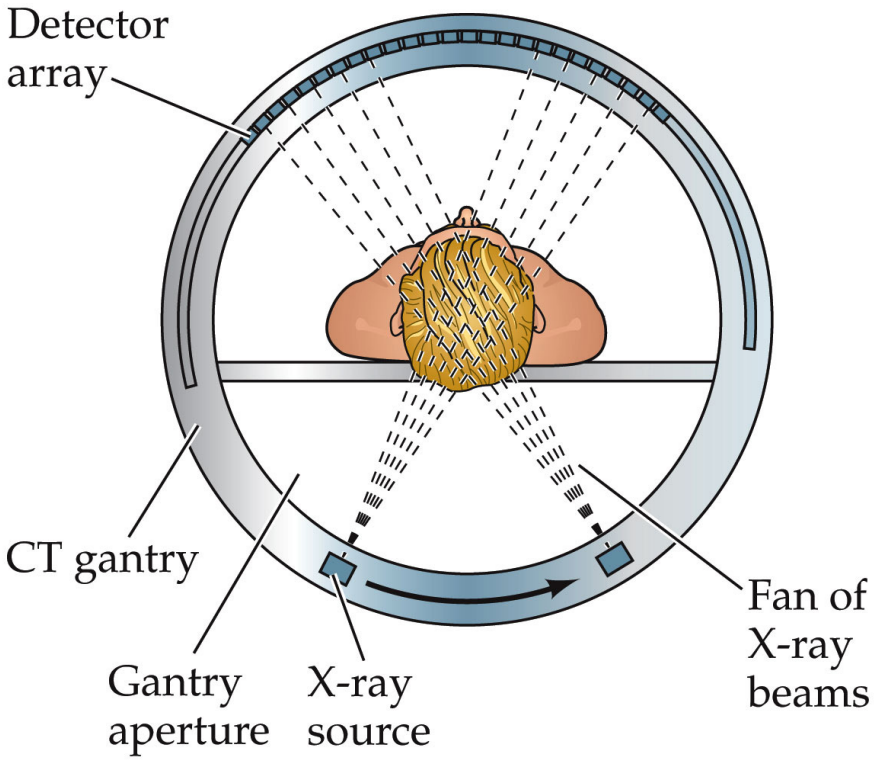


Medical retirement from sport after concussions

A practical guide for a difficult discussion.

Correspondence

Schematic Diagram of CT Scanning Gantry



NEUROANATOMY 2e, Figure 4.2

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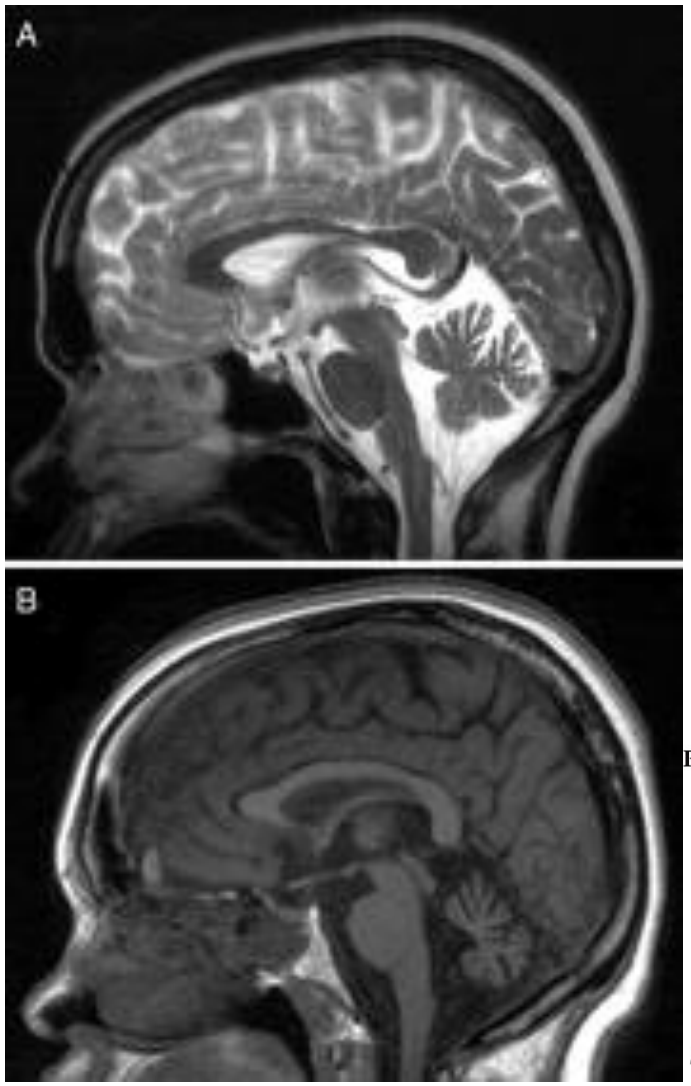
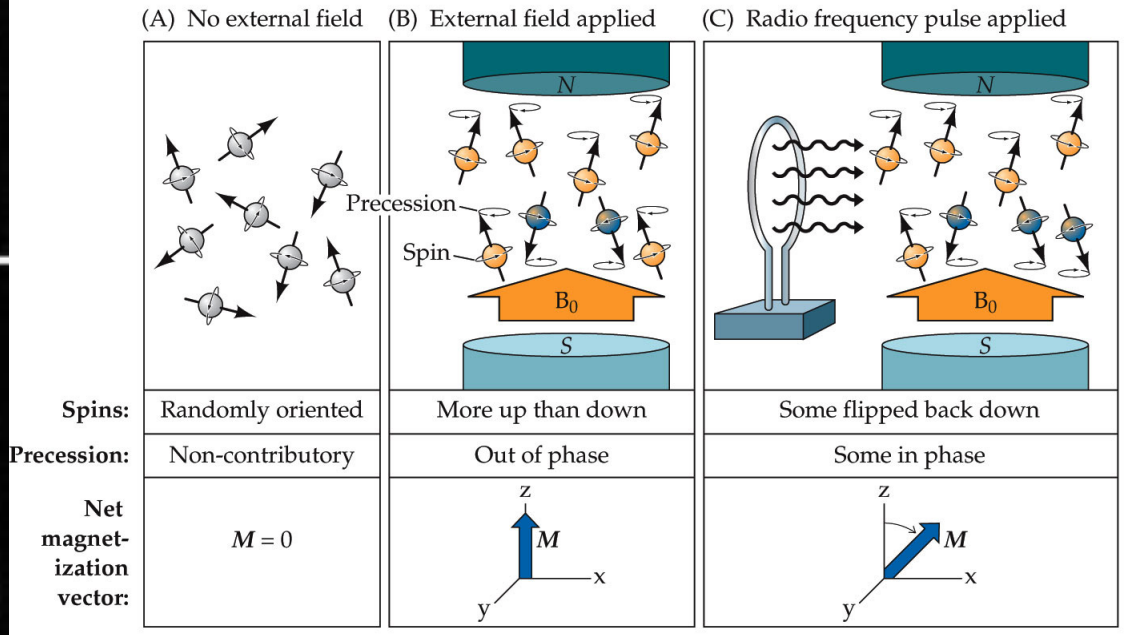
Magnetic Resonance Imaging





***NEUROANATOMY 2e*, Figure 4.5**


Concussions are a serious brain injury.
Concussion Awareness Week • Sept 26 - Oct 2
Learn more at www.cattonline.com
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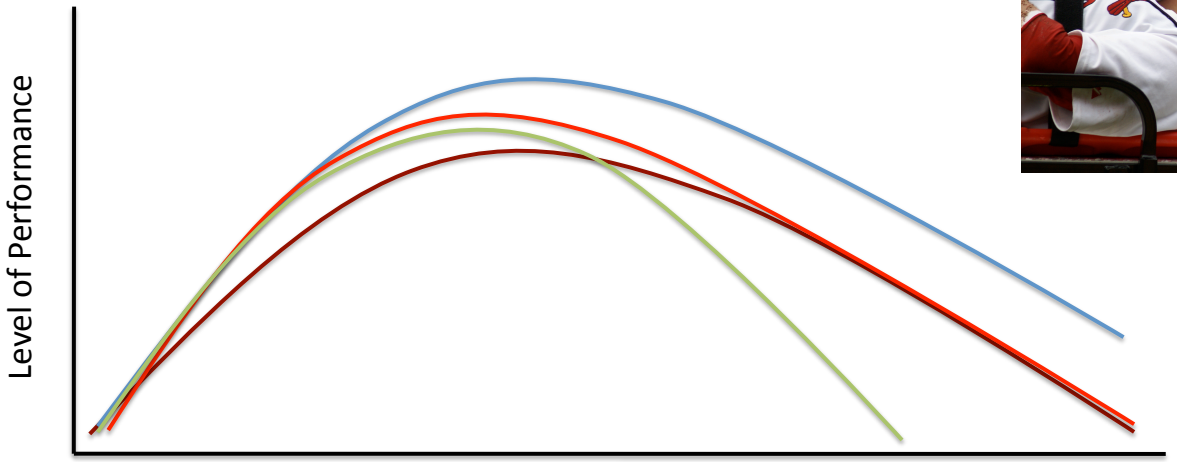
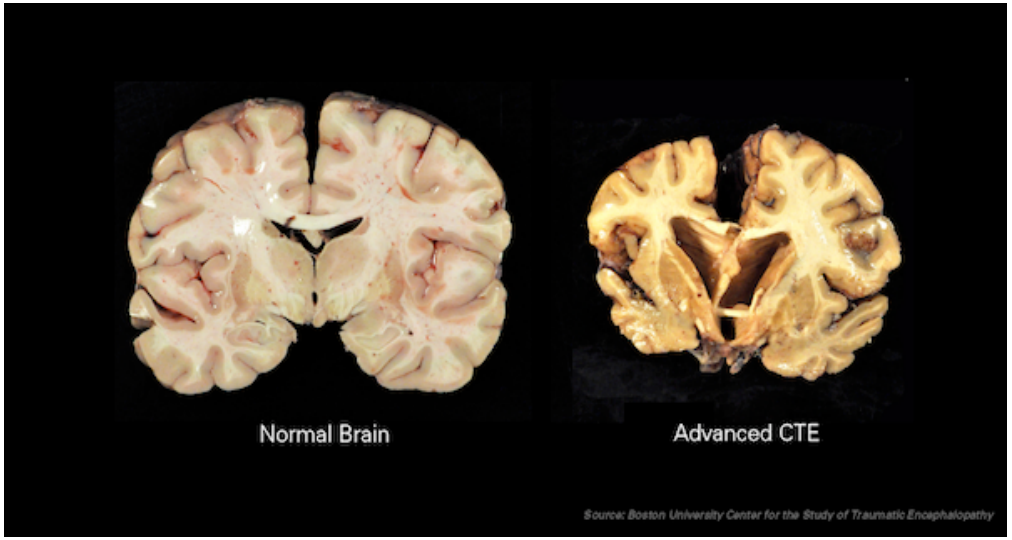

Level of Performance
Lifespan

Dr. Bennet Omalu

Chronic Traumatic Encephalopathy: A unique type of tauopathy



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CTE Neuropathology

The gross neuropathology, described as "characteristic" of CTE, includes:

1) frontal and temporal atrophy, thinning of the hypothalamic floor, shrinkage of the mammillary bodies, pallor of the substantia nigra, hippocampal sclerosis, and reduction in brain mass

2) enlarged ventricles

3) cavum septum pellucidum with or without septal fenestrations.

Microscopic features described as characteristic have included:

1) localized neuronal and glial accumulations of phosphorylated tau (p-tau) with varying microscopic morphologies, involving perivascular areas of the cerebral cortex and sulcal depths

2) multifocal axonal varicosities involving deep cortex and subcortical white matter

3) variable and often absent Beta amyloid deposits

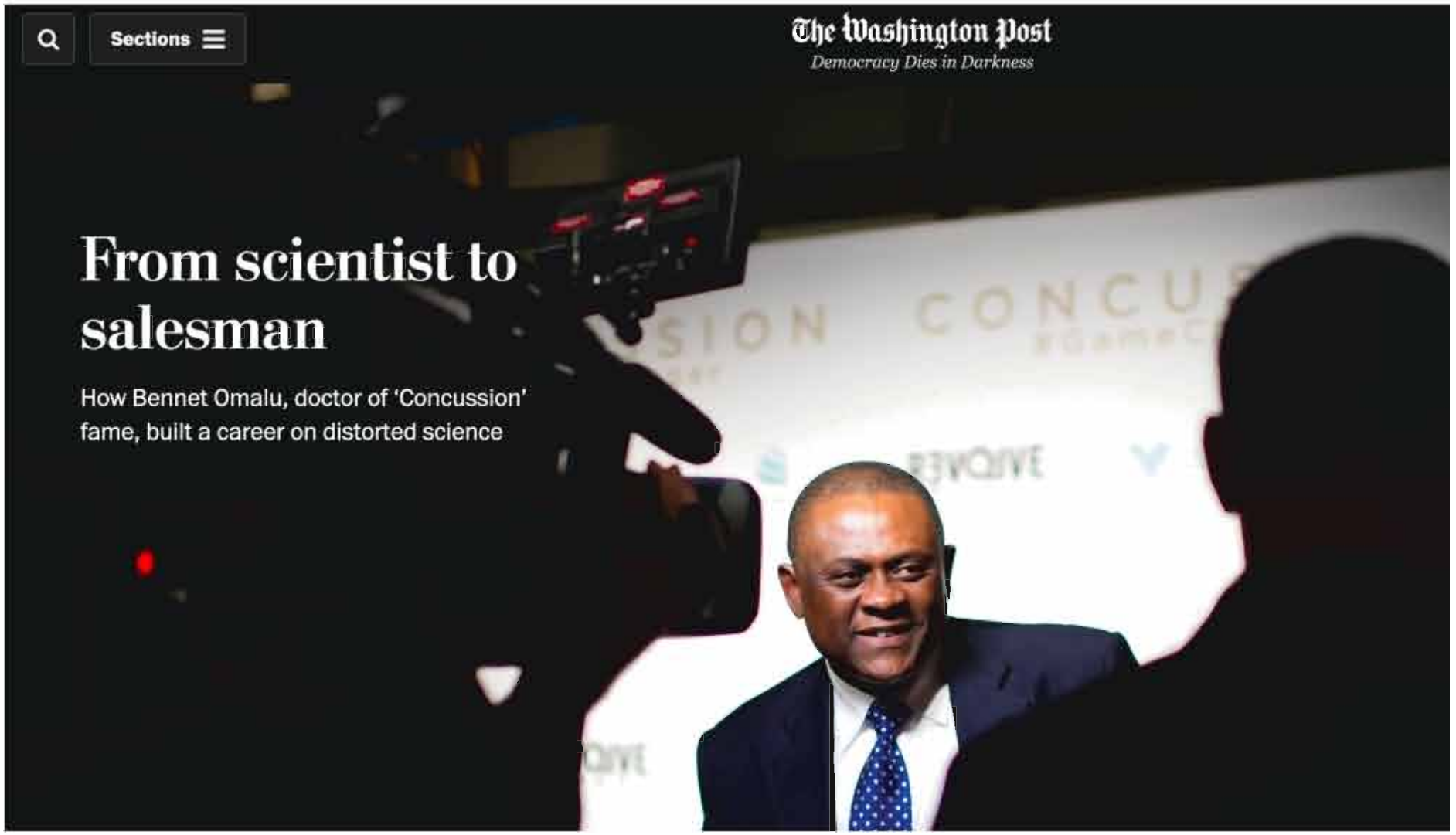
4) TDP-43-positive inclusions and neurites.

Iverson et al., 2018, Journal of Alzheimer's Disease 61, 17–28

The Washington Post
Democracy Dies in Darkness

From scientist to salesman

How Bennet Omalu, doctor of 'Concussion' fame, built a career on distorted science



Journal of Alzheimer's Disease 61 (20
DOI 10.3233/JAD-170654
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Review

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Archives of Clinical Neuropsychology 35 (2020) 332–341

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Retired National Football League Players are Not at Greater Risk for Suicide

Grant L. Iverson*

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Editorial Decision 25 April 2019; Accepted 29 April 2019

Risk of Misdiagnosing Chronic Traumatic Encephalopathy in Men With Depression

Grant L. Iverson, Ph.D., and Andrew J. Gardner, Ph.D.

BRAIN INJURY

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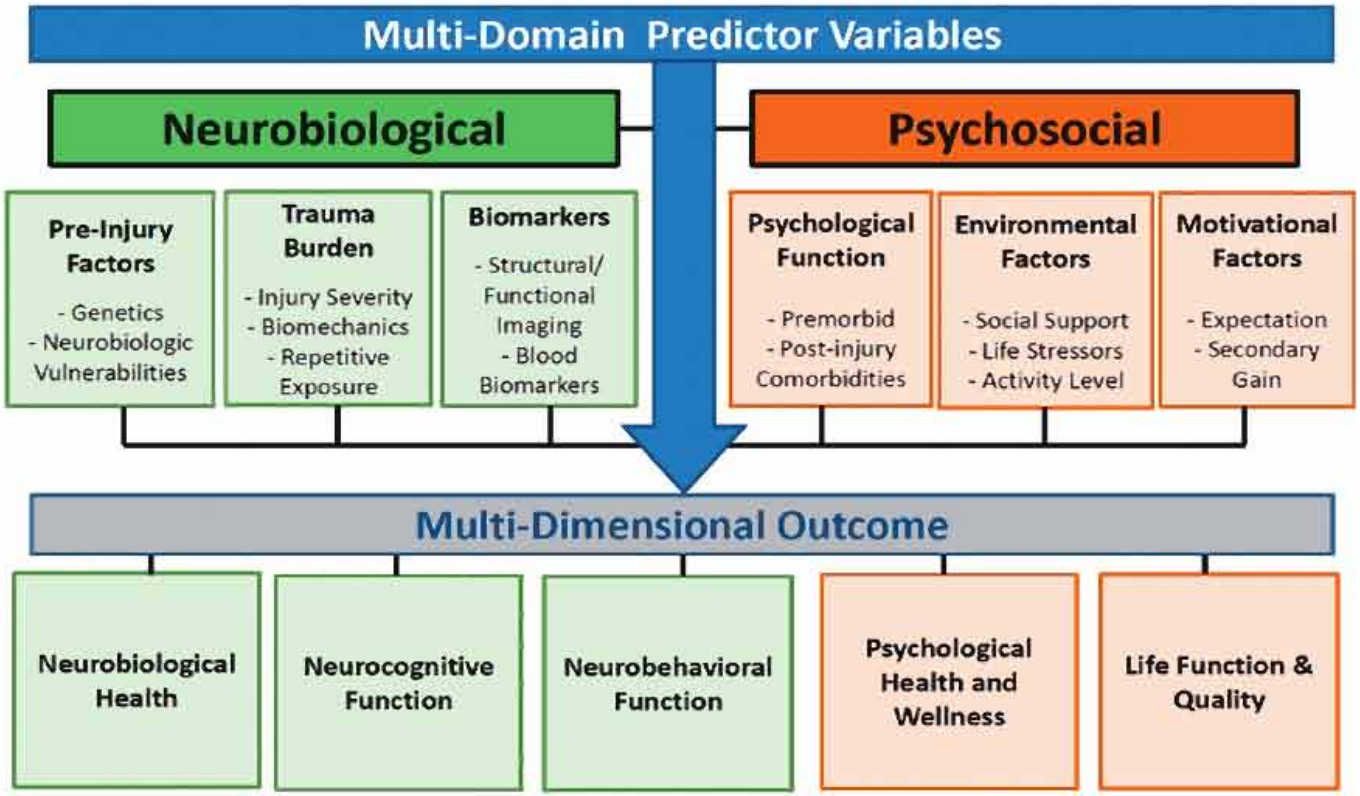
REVIEW

Sports concussion assessment and management: Future research directions

Michael McCrea[1,2], Dennis K. Broshek[3], & Jeffrey T. Barth[3]



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Resilience
prevent
strength
grow
idea
success
vision
growth
agility
motivate
effort
believe
trouble
business
overcome
stability
vitality
active
possible
change
empowering
persistence
reaction
experience
impossible
leadership
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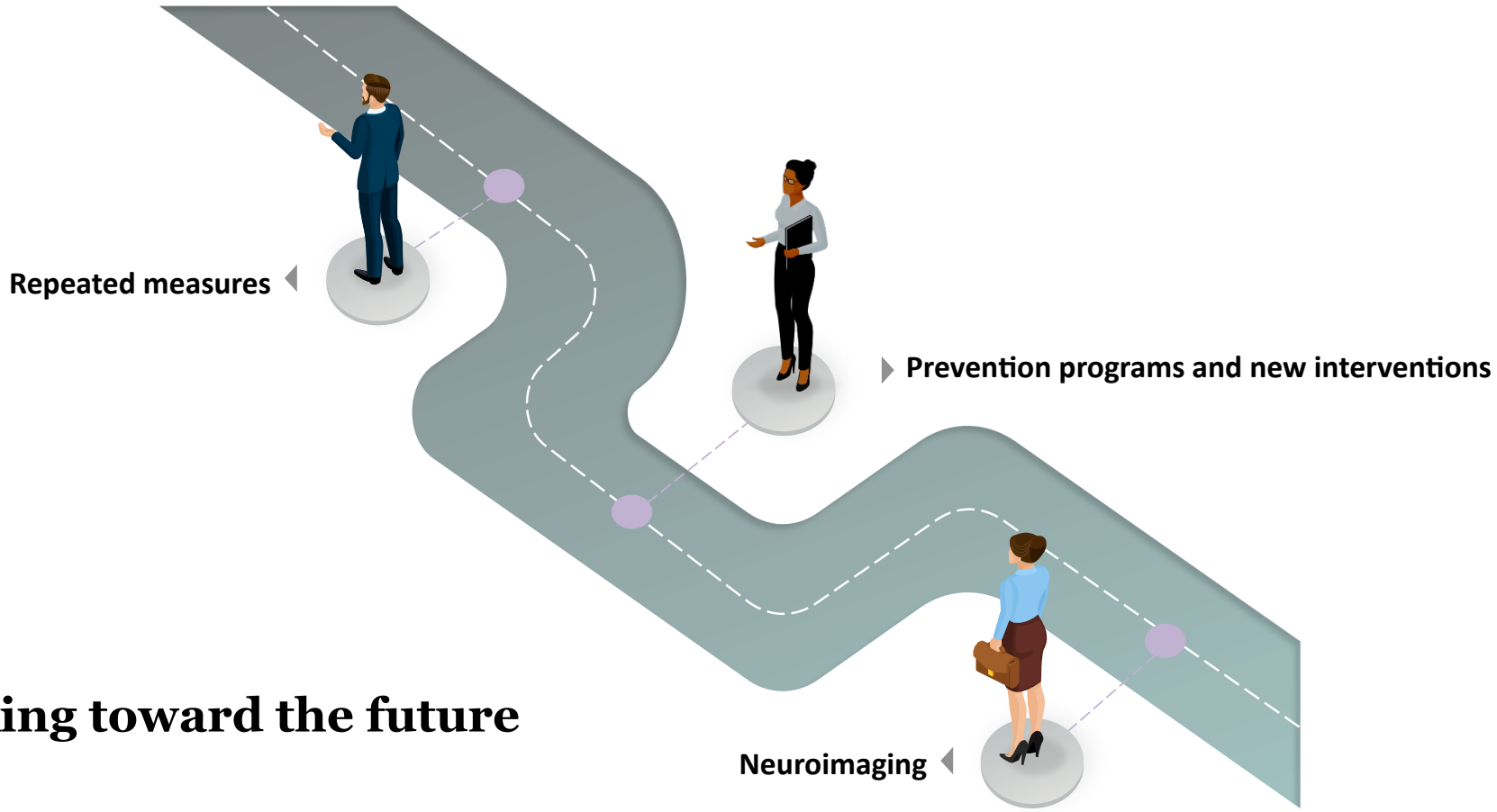
Looking toward the future



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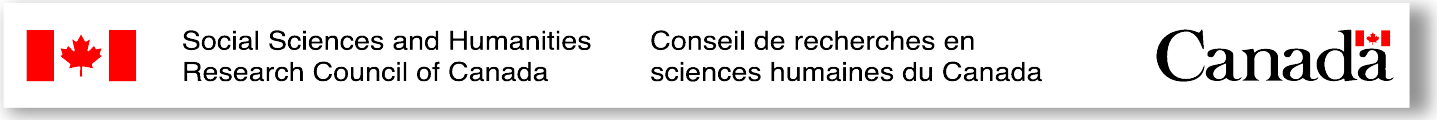
Funding sources



GRACIAS!

THANK YOU!

QUESTIONS?