Brain Injury: An Uphill Road

Where did all these bumps come from?

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Brain Injury: An Uphill Road

- Why is the brain injury journey so tough?
  - What happens to a brain when injured?
- How do those injuries affect the survivors?
  - What problems does it cause?
- Reasons for hope down the road.

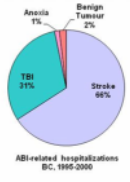
Introductions

- Me: a prof in PSYC at UVic,
  - Have been working at brain injury research for past 20 years
  - I am an academic, a researcher, not a clinician.
  - I look at common features, not individual cases
- You: Who is here tonight? "Health and Helping Professionals"?
  - Medical: Nurses? Doctors? Others?
  - Private or Non-profit?
  - Survivors? Family members
- Goal: Two guys in a balloon

Content and Hope

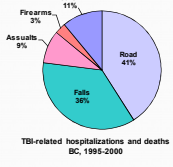
- My information will cover the basics of
  - What parts of brain are damaged
  - How this produces particular problems
  - Current thinking about brain recovery mechanisms
  - Reasons and sources of hope
- Purpose: information may lead to
  - Better understanding
  - Better coping by or with survivors and family

Common Causes: ABI



- Stroke
  - Interrupted blood flow
  - Mostly in people over 55
- Traumatic Brain Injury
  - Blow to the head
  - Mostly males, 18-25
- Anoxia – lack of oxygen
- Penetrating brain injuries
  - Surgery (tumours), small fast objects

Common Causes: TBI



- Road accidents
  - Cars, trucks, bikes, pedestrians
- Falls
  - work, home, sports
- Assaults
  - Blows, hitting ground
- Firearms
  - Usually fatal, mostly suicide

Common Effects

- Strokes and Penetrating Head Injury
  - Effects are specific to where the neural tissue was damaged
    - Paralysis, other motor loss, speech loss
- TBI
  - Many different effects and problems
    - All at once.
  - Variable from person to person
    - Deficits
    - Severity
    - Recovery

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Common Problems: TBI

Top 10 (things that impact on everyday life)

1.	Fatigue	2
2.	Pain	3
3.	Organizing	4
4.	Language Expressing	4
5.	Memory - Recent	4
6.	Economic Security	4
7.	Health Satisfaction	4
8.	Multi-tasking	4
9.	Emotional Reactivity	4
10.	Sustained Attention	4 (10 = "It's fine", 1 = "It's really bad")

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Common Problems: TBI

Top 10 issues: How they cluster

1.	Fatigue	2	Global
2.	Pain	3	
3.	Organizing	4	"Mind"
4.	Language Expressing	4	
5.	Memory - Recent	4	Memory
6.	Economic Security	4	Sum of Everything
7.	Health Satisfaction	4	
8.	Multi-tasking	4	
9.	Emotional Reactivity	4	"Mind"
10.	Sustained Attention	4	

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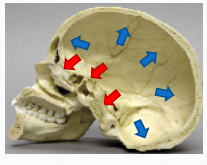
Global Problems: Brain Causes

- Skull is hard
  - Some of inside is smooth
  - Some is jagged
- Brain is soft.
- In TBI, skull gets bumped around
  - And brain moves inside the skull
  - When the skull stops, the brain hits inside of skull
  - And bounces, and hits again



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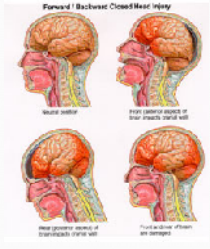
Global Problems: Brain Causes

- Head rotates back and forth
- Or side to side



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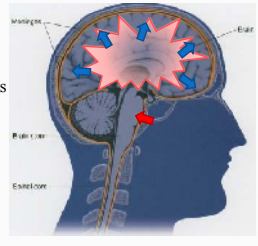
Global Problems: Brain Causes

- Skin of brain (meninges) gets bumped and bruised
  - Little blood vessels break or are bruised
- Lots of outer brain (cortex) gets bumped and bruised
- Stem of brain (brainstem) can be stretched
- Fine connecting fibers (axons) get stretched or broken.
  - → "Diffuse Axonal Injury"



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Global Problems: Causes and Effects

Cause (Damage)	Effect (Function)

• Meninges & blood vessels
  • Other sources too
	• Pain: Headache
	  • Possibly migraine
	  • Chronic (for 6-12 mo)

• Outer brain & brainstem
  • Cells working harder to make up for losses
  • Sleep wake control centre
	• Fatigue and sleep
	  • Tired more
	  • Trouble sleeping
	  • Circadian rhythms off

• Diffuse axonal injury
  • Cells harder to excite
  • Messages slowed
  • Playing "a man short"
	• Everything harder to do
	  • takes more time
	  • takes more effort

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Brain Anatomy

- Different functions in different areas.
- Damage in different areas → different functional problems

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Mind Problems: Brain Causes

Frontal Lobe Damage

- Front of brain
  - Hits front of skull
- Brain above eyeballs
  - Hits skull above eyeballs
- Frontal lobe = Control centre
  - Planning, organizing
  - Action coordinator
  - Emotion Interpreter
  - Behaviour Inhibitor

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Mind Problems: Causes and Effects

Control Center	"Frontal" Problems

• Planning, organizing	• Disorganized
	  • Putting things in order
	  • Being on time

• Action coordinator	• Attention problems
	  • Focusing on 1 thing
	  • Doing 2 things at once

	• Sequencing • thoughts, words, actions

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Mind Problems: Causes and Effects

Control Centre	Frontal Problems

• Emotion Interpreter
  • Internal
  • Context
  • Awareness – self, others
	• Emotional reactivity
	  • Intense emotions
	  • Poor emotional control
	  • Social blindness

• Behaviour Inhibitor
  • "Second thought"
  • Social inhibitions
	• Social Problems
	  • Impulsiveness
	  • words, actions
	  • Loss of "manners"
	  • Inappropriate behaviour

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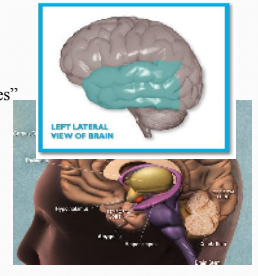
Memory Problems: Brain Causes

Temporal Lobe Damage

- Front of temporal lobes
  - hits front of temporal "caves"
- Hippocampus
  - Deep in temporal lobe
  - Most vulnerable
    - Canary in mine-shaft
    - Oxygen and blood flow
    - Input and output fibres
      - Stretched and broken



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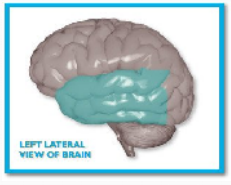
Memory Problems: Causes and Effects

- Front of temporal lobes → "Tip-of-the" tongue
  - Function: Object ID
  - Object naming
  - Word finding



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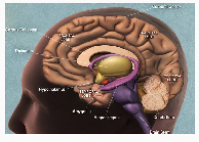
Memory Problems:Causes and Effects

- Hippocampus → Memory problems
  - Effortless learning
  - Time and space
  - Sketchy "recent memory"
    - Names and places
    - Events (episodes)
- Navigation by intuition → Getting lost
- ⇨ Spared memories
  - Pre-injury memories
  - Emotional associations
    - Partner
    - Smells, food



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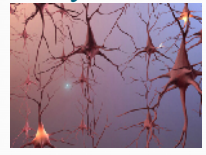
Hope: Neuroplasticity



- Problem for recovery
  - No (or few) new neurons. ☹
  - No axon healing. ☹
- "Neuroplasticity"
  = the brain's ability to change ☺
  - By rewiring connections between neurons
  - Connections = "synapses"
    - The gateway of information

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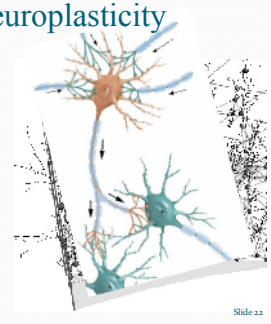
Hope: Neuroplasticity

- Neurons connected to many other neurons
- Information comes in through synapses
  - Cells need input from many inputs (5,000)
- Form networks of interconnected cells



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Hope: Neuroplasticity

- Sending cell talks, receiving cell listens
- Cells need many inputs to get excited
- Analogy: collecting money for office gift
  - $5 from 30 people → great gift (exciting)
  - If staff cutbacks (2/3)
    - $5 from 10 people → ok gift.
    - Harder, slower to get exciting gift
    - Unless each gives $10
      - and expectations reduced
- Synapses change in same way
  - Each can get stronger, cell gets more easily excited

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Hope: Neuroplasticity

Mechanisms of Recovery (Brain changes)

1. Recovery from "Brain Shock" (Diaschisis)
2. Sprouting
3. Rewiring (& relearning)

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Hope: Neuroplasticity

Recovery from "Brain Shock" (Diaschisis)

- After injury, some neurons lose inputs
  - The are ok but can't get excited enough
  - Not enough inputs
  - Brain area goes "off-line"
- With time and use, remaining inputs gain strength
  - And so shut-down neurons get active again
  - Brain areas comes back "on-line"
  - Like "office gift" analogy (↑ inputs, ↓ threshold)

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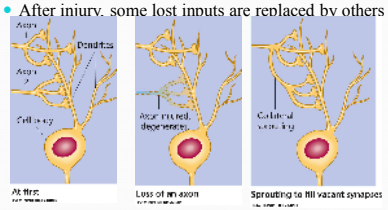
Hope: Neuroplasticity

Mechanism 2: Sprouting

= Reconnecting "De-friended" cells

- After injury, some lost inputs are replaced by others nearby



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Hope: Neuroplasticity

Mechanism 3: Rewiring (relearning)

- All learning rewires brain connections
- Sometimes damaged area → complete loss of a function
- Need to learn to do tasks using another area of brain
  - Called "Behavioural compensation"
  - = Work-arounds
  - E.g., Memory books, Post-it notes
- Basis of most rehab therapy (Best we have so far)
  - Using what's left.

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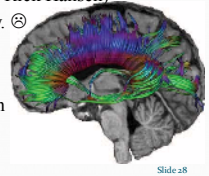
Hope: Research

Long-term (General recovery)

- Cellular mechanisms of recovery
  - Neurogenesis – new neurons ☺ (E.g., UVic)
  - Axon regrowth ☺ (e.g., iCord – Rick Hansen)
  - Spinal cord repair10 years away. ☹
- Brain Imaging
  - Better MRI scans
  - "DTI" Imaging of axon function



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Hope: Research

Long-term (1 specific deficit): Spatial navigation

- We study navigation using virtual reality
- We have found what TBI survivors can and can't do
- Future: How TBI survivors might navigate better
- Future: How to train survivors to navigate better

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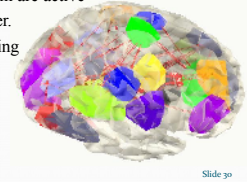
Hope: Research

Long-term (Neural changes after brain injury)

- Spatial navigation and EEG
  - EEG during navigation in virtual reality (new analysis)
  - Shows what areas of the brain are active
    - And activating each other.
  - Future: What might be missing after TBI



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Hope: Research

Medium term

- Better measurement of outcome (and rehab)
  - 3 new measurement tools ☺
  - We have developed one that listens to survivors ☺
  - Takes valuable rehab time ☹
- Better Rehab methods
  - Usually by Rehab professionals – trying very hard ☺
  - Slow spread of information ☹

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Hope: Research

Medium term (UVic)

- Community-based research
  - Growing in popularity
  - University researchers working on questions community wants answered
  - UVic-United Way working together
    - Along with other funders

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Hope: Research

Medium term

- Community-based research: Coping Skills and Well-being
  - At VBIS, PG's Coping Skills program
  - UVic (me + collaborators)
  - Program: Weekly for 3 weeks, group, peers
  - Assessment: Pre and Post
    - Everyday functioning, satisfaction
    - Affect, Well-being, Coping
    - Study in progress

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Best hope for survivors <u>now</u>.

- Use it or lose it? Don't lose it. Staying active:
  - Mind and Body
  - Exercise and Fun
- Purpose in Life
  - Working towards goals
- "Happiness comes from between"
  - Family and friends
- Church?
  - Works for some

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Best hope for survivors now.

- Resources
  - Internet
    - My website (http://web.uvic.ca/psyc/skelton/)
    - Google and YouTube
- Books
  - For survivors and family
  - Links to books at Amazon.ca on my website
- Community Head/Brain Injury Societies
  - Tremendous benefit: Direct, social

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Summary: Neuropsychology

- TBI cause – blow to head
- TBI Effects
  - Generalized damage → Fatigue, pain, slowed processing
  - Frontal damage → Problem behaviours
  - Temporal lobe damage → language and memory problems
- TBI Recovery
  - Neural plasticity
- TBI hope
  - Research into improving plasticity

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Summary: Clinical Psychology

- TBI cause – Traffic, sports, crime (trauma)
- TBI Effects
  - Fatigue, pain: accommodate needs of clients
  - Problem behaviours: Help client and family recognize origin
  - Language and memory problems: patience, memory books
  - Trauma and loss
- TBI Recovery
  - Behavioural compensation, psychotherapy
- TBI hope
  - Natural recovery, support from family and community

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On the Road: Survivors are not alone

- Each survivor's brain injury is unique
  - But many survivors face similar problems
- Many problems have known causes
  - Though no "cures" yet.
  - Only work-arounds
- Yes, there is life after brain injury.
- People care and can help
- It's a tough road, but there are many people on it.

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Research Partners

- Michael Joschko – Functional Outcome Profile (ICBC)
- Ann Mariscak – TBI/ABI Incidence (BCBIA)
- Sharon Livingstone – TBI and Spatial Navigation (NSERC)
- Philip Zeman – TBI and EEG (CANASSIST)
- Coping Skills
  - VBIS – Leidi Fortner (United Way)
  - UVic – Fred Grouzet, Stacey Ross (Uvic)

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Thank you.

- Questions?

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