Tailoring Interventions to Promote Recovery following Acquired Brain Injury

Professor Shari Wade
Tailoring Interventions to Promote Recovery following Acquired Brain Injury: Do We Need a Separate Program for Each Symptom?

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  • H. Gerry Taylor, Ph.D. Case University
  • Terry Stancin, Ph.D. Case University
  • Keith Owen Yeates, Ph.D., University of Calgary
  • Michael Kirkwood, Ph.D., Children’s Hospital of Colorado
Overview

• Review of challenges facing children and youth following ABI
• Consideration of evidence-based approaches to addressing specific symptoms or concerns
• Consideration of comprehensive approaches
• Who is likely to benefit from each
Acquired Brain Injury: Physical Consequences

- Fatigue
- Sleep difficulties
- Changes in appetite and weight
- Motor impairments
Potential Interventions for Physical Problems

- Intervention to address sleep hygiene, medications
- Aerobic exercise interventions to address weight issues and fatigue.
  - Studies with mTBI suggest that aerobic exercise may also improve cognitive function post TBI.
Cognitive Consequences

- Problems with attention, working memory and executive function skills
- Speech and communication difficulties
- Specific learning disabilities (reading, math)
Interventions Addressing Cognitive Consequences

- Direct attention training
- Training in problem-solving, planning, and organization (executive function skills)
- Metacognitive strategy training
- Remediation of specific skills/errorless learning
- Speech/language therapy
Behavioral Consequences

- Impulsivity, poor self-regulation
- Anger issues and aggression
- Depression, anxiety, internalizing symptoms
- Post traumatic stress disorder
- Apathy and withdrawal
Interventions Targeting Behavioral Consequences

- Environmental interventions reinforcing targeted behaviors
- Antecedent behavior management (shaping the environment to avoid behavior problems)
- Anger management training
- Cognitive behavioral therapy for depression and anxiety
- Medications
Social Consequences

- Social skill and social problem-solving deficits
- Impaired emotion recognition
- Changes in peer relationships
- Difficulties making and maintaining friendships
- Social isolation
- Lack of participation
Interventions to Improve Social Outcomes

• Social skills training
• Peer mentors
• Training in emotion recognition
• Training in communication skills
Deciding Where to Intervene

- Few problems occur in isolation (some children may have isolated learning difficulties).
- Social environmental and family characteristics are important determinants of behavioral, social, and adaptive outcomes (Anderson et al., Yeates et al., 2010; Taylor et al., 2002).
- Cognitive, behavioral and social consequences are likely causally interrelated.
Model of Social Competence (SOCIAL) (Beauchamp & Anderson, 2010)

Mediators

Cognitive Functions

Social Competence

- Internal/External Factors
- Brain Development and Integrity

- Attention-Executive
- Communication
- Socio-Emotional

- Social Skills/Function
SOCIAL Model Points of Intervention

• Mediators/Moderators
  • Parenting
  • Family Functioning
• Cognitive Factors
  • Attention
  • Working Memory
  • Executive functions/problem solving
• Communication
  • Language pragmatics
• Social/Emotional
  • Behavior regulation/externalizing behaviors
  • Depression/anxiety
• Social Skills
Pediatric Neurocognitive Interventions Model (Limond, Adlam & McCormack, 2014)

<table>
<thead>
<tr>
<th>Level</th>
<th>Cognitive Impairments</th>
<th>Intervention Aim</th>
<th>Examples of Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>Specific cognitive skills e.g. episodic memory, visual processing, language skills</td>
<td>Compensatory strategies to be used independently</td>
<td>Training in the use of e.g.; elaborative encoding, retrieval strategies, visual compensations</td>
</tr>
<tr>
<td>C</td>
<td>Evaluative skills e.g. metacognition, supervisory processes, and reasoning</td>
<td>Training to support general cognitive functioning</td>
<td>Training of e.g. goal management skills, prospective reminding, “stop and think”</td>
</tr>
<tr>
<td>B</td>
<td>Core skills e.g. working memory, inhibitory control, processing speed, and sequencing</td>
<td>Remediation of skills</td>
<td>Intensive practice e.g. working memory, attention process, and speed training</td>
</tr>
<tr>
<td>A</td>
<td>Semantic knowledge, adaptive functioning and specific cognitive skills (e.g. episodic memory)</td>
<td>Compensatory strategies, cued and supported by others</td>
<td>Providing techniques such as precision teaching, errorless learning, elaborative encoding and rehearsal</td>
</tr>
</tbody>
</table>

Psychosocial and Systemic Foundations - Supporting health needs, sensory impairments, pragmatic and social care issues (e.g. visual processing, diet, exercise, financial, and practical resources). Addressing systemic factors (e.g. family chaos). Ensuring positive behavioral support for challenging behavior. Accessing parenting skills training to ensure development of emotional competence. Providing psychotherapy for mood disorders.
# Pros and Cons of Targeted versus Comprehensive Interventions

| **Targeted**                                                                                                       | **Comprehensive**                                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| • Can achieve mastery on the specific skill or skills within a limited time frame.                               | • Can address multiple issues in a single intervention.                                                  |
| • May need to conduct multiple targeted interventions to achieve any observable changes in everyday settings.     | • Can target social environmental facilitators and barriers.                                             |
| • Likely to have minimal impact on environmental factors that may influence behavior.                              | • If there are underlying skill deficits, may need to identify external strategies for compensation.    |
|                                                                                                                   | • May achieve more limited change on specific underlying deficits.                                      |
## Attention Training versus Family Problem Solving: A Contrast of Symptom-Specific versus Global Approaches for a Common Issue following ABI

<table>
<thead>
<tr>
<th>Attention Training</th>
<th>Family Problem Solving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skill-based</td>
<td>Strategy-based</td>
</tr>
<tr>
<td>Grounded in neural plasticity theory</td>
<td>Grounded in theory on environmental moderators and positive behavioral supports</td>
</tr>
<tr>
<td>Emphasis on repeated drills, high intensity of practice</td>
<td>Emphasis on application to everyday problems in real world settings</td>
</tr>
<tr>
<td>Often decontextualized</td>
<td>Uses family to support problem implementation and solutions</td>
</tr>
<tr>
<td>Centered on youth with ABI</td>
<td></td>
</tr>
</tbody>
</table>

- Attention Training is skill-based, grounded in neural plasticity theory, emphasizes repeated drills, is high intensity practice, often decontextualized, and centered on youth with ABI.
- Family Problem Solving is strategy-based, grounded in theory on environmental moderators and positive behavioral supports, emphasizes application to everyday problems in real world settings, and uses family to support problem implementation and solutions.
Mechanism of Effects

Direct Intervention/Attention Training

- Mismatch between environmental demands and possibilities of current structural system.
- Attention training specifically strengthens the neural networks underlying control processes.
- By strengthening working memory, a constellation of related processes will be improved.

Problem Solving Training

- Compensatory techniques.
- Neural systems accomplish complementary cognitive and behavioral outcomes.
- Supplementary behaviors and environmental resources support cognitive processing.
Intervention Approaches

Distinction between approaches that target a particular cognitive domain via practice exercises versus training strategic behavior

- *Direct Attention Training vs. Strategy Instruction* (Sohlberg & Turkstra, 2011)
Evidence for the Efficacy of Direct Attention Training

- Galbiati and colleagues (2009)
  - 65 patients (with 25 as non-treated controls) with TBI, ages 6-18
  - significant improvements on the CPT and parent-reported adaptive behavior at post-testing and 1 year follow-up

- Hardy and colleagues (2011)
  - 9 survivors of ALL or brain tumor with attention and working memory deficits, ages 10-17
  - significant increases in working memory and decreases in parent-rated attention problems

- Hardy and colleagues (2013)
  - 20 survivors of ALL or brain tumor with attention and working memory deficits, ages 8-16, randomized to success-adapted computer intervention or a non-adaptive, active control condition
  - significant improvements in visual working memory and parent-rated learning problems
Evidence for the Efficacy of Attention Training Plus Strategy Training

- Butler and colleagues (2008)
  - 161 survivors of childhood cancer involving CNS, ages 6-17, with attentional deficit; 2/3 of children randomized to treatment
  - significant increases in academic achievement and parent report of improved attention
- Zou and colleagues (2012)
  - Subsample of Butler et al. who underwent fMRI
  - brain activation during attention task diminished at baseline, increased following remediation, and at 6-month follow-up
- van’t Hooft and colleagues (2007)
  - 38 children with ABI, ages 9-16, randomly assigned to treatment
  - significant improvement in sustained and selective attention and verbal working memory at post-test and 6-months post
- Sjo and colleagues (2010)
  - 8 children with ABI, ages 11-15
  - significant improvements in learning and memory
AIM: Attention Improvement Management

Key Development Considerations

• Integrate both strategy training and process-oriented training
• Facilitate high treatment dosage
• Develop task options grounded in attention theory
• Task selection and strategy selection driven by individual client profile and ongoing performance
Principles of AIM

• Theoretically-grounded model of attention
  ✓ Basic Sustained Attention
  ✓ Executive Control: Selective Attention
  ✓ Executive Control: Working Memory
  ✓ Executive Control: Suppression
  ✓ Executive Control: Alternating Attention

• Provide sufficient repetition using hierarchically organized exercises

• Teach & practice individualized metacognitive strategies

• Client performance drives therapy plan

• Facilitation of generalization through Goal Attainment Scaling
Select items that describe Sarah's typical or regular behavior across days and settings:

### Attention Domain

#### Sustained

The ability to maintain attention during continuous and repetitive activities.

**Some examples:**
- Switches between activities/tasks frequently and haphazardly
- Stops working when task get challenging
- Has difficulty attending (listen/watching) to prolonged instruction

#### Selective

The ability to selectively process target information while inhibiting responses to non-target information.

**Some examples:**
- Distracted by things in the environment
- Struggles with open-ended tasks
- Doesn't return to a task when interrupted

#### Working Memory

The processes required for holding on to and manipulating information in one's head such as is required when doing mental calculations.

**Some examples:**
- You may return to and edit this form at any time in the future.

### Significance of the Difficulty?

#### How much of a problem does this student have with this range of behaviors

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Problem</td>
<td>Slight</td>
<td>Mild</td>
<td>Moderate</td>
<td>Significant Problem</td>
</tr>
</tbody>
</table>

Continue

Skip to Menu
Options for Selected Strategies

Personalize the wording for the strategies you selected on the previous screen. If you are unsure about the support level, you may leave it on the default setting.

Take a deep breath with long exhale when attention starts to fade.

Use This Wording

Internal self talk

Attention Domain Examples:

Sustained Example:
When attention starts to fade, tell self your motivation words – 'keep on'.

Use This Wording

Personalized Strategy Wording:
Feel free to modify or write your own wording.

FINISH!!

Support Level:

- Full
- Moderate
- Faded

Print Strategy Worksheet

Continue

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AIM Program for Sarah

Estimated length of AIM program: 30 minutes

**Sustained Attention Tasks:**
- Listening for 1 Letter in a Word with female clinician (slow)

**Selective Attention Tasks:**
- Listening for 1 Number with Environmental noise distraction and female clinician (slow)

**Working Memory Tasks:**
- Matching Animals (2-back) (slow)
- 5 4-Word Sentences (Alphabetical) with female clinician

**Suppression Tasks:**
- Serious-Silly intonation with button response (slow)

**Alternating Attention Tasks:**
- Big-Small Word Size (slow)

If you would like to edit/change any of the above tasks, click on the Edit Tasks button.

Edit Tasks

Continue

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Outcome: Attention and Executive Function Tests

Standardized Tests:

- Delis-Kaplan Executive Function System (D-KEFS)
  - Subtests: Trail Making, Word Interference, Tower
- Test of Everyday Attention-Children
- Parent and Self-report Measures
- Behavioral Rating Inventory of Executive Functions (parent and self report)
- Goal Attainment Scaling
Personalized Goal Attainment Scale to Address Reading

Goal Attainment Scale for Bronson

Date to evaluate: Mar 20, 2012

<table>
<thead>
<tr>
<th>GAS Level</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>+2</td>
<td>Best expected outcome</td>
</tr>
<tr>
<td>+1</td>
<td>More than expected outcome</td>
</tr>
<tr>
<td>0</td>
<td>Expected outcome</td>
</tr>
<tr>
<td>-1</td>
<td>Less than expected outcome</td>
</tr>
<tr>
<td>-2</td>
<td>Worst expected outcome</td>
</tr>
</tbody>
</table>

Your Goal Attainment Scale for Bronson has been created. You may now continue on to the main menu for orientation and running the AIM program.

Print this Goal
Continue to Menu

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Who Did It Work For: A Clinician’s Perspective

- Youth with few behavior problems
- Youth who were highly motivated to improve
- Youth with supportive families who provided reminders and reinforcement for daily practice
- Youth with relatively good premorbid functioning/cognitive reserve
Case Example: Sunny

- A 14 year old Black male, had just completed 8th grade at start of program
- Sustained a complicated/mild TBI at age 6
- Difficulties with working memory and sustained attention
- Had issues with task completion, especially ones with multi-step directions. Mother reported he often needed reminders while completing a task and would return at least once to ask “what was I supposed to do?”
- Working memory and attention difficulties were evident on parent-report measure and relative weaknesses were demonstrated on neuropsychological assessments requiring auditory attention
Metacognitive Strategies

• Deep breathing
  • Used when needed to refocus or felt frustrated

• Repeating or clarifying information
  • Regularly reminded himself of directions/steps while completing chore or task
**Sunny’s Goal Attainment Scale**

**Goal:** Improve focus and complete tasks quickly/effectively  
**Person to monitor:** Parent  
**Date to evaluate:** May 28, 2014

<table>
<thead>
<tr>
<th>GAS Level</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>+2 <strong>Best expected outcome</strong></td>
<td>Stay focused regardless of how long the task takes (greater than 45 minutes)</td>
</tr>
<tr>
<td>+1 <strong>More than expected outcome</strong></td>
<td>Stay focused for 40 minutes on a task</td>
</tr>
<tr>
<td>0 <strong>Expected outcome</strong></td>
<td>Stay focused for 30 minutes on a task</td>
</tr>
<tr>
<td>-1 <strong>Less than expected outcome</strong></td>
<td>Stay focused for 20 minutes on a task</td>
</tr>
<tr>
<td>-2 <strong>Worst expected outcome</strong></td>
<td>Stay focused for 10 minutes on a task</td>
</tr>
</tbody>
</table>
Sunny’s Performance in the Program

• Highly motivated, mother also invested in the program
• Completed 11 sessions and practiced an average of 4 times per week between sessions
• Actively worked to implement his strategies of staying focused and repeating the instructions during chores at home and during sport practices (basketball/football)
• Worked during AIM practices to maintain focus throughout the games and for full 30 minutes of session
  • Error pattern towards ends of tasks
Pre- to Post-Treatment Changes in Attention and Switching (Improvements Across Areas)
Pre- to Post-Treatment Changes on the Self Report BRIEF (Improvements in Most Domains)

![Bar chart showing improvements in various domains post-treatment compared to pre-treatment.](image)

- Inhibit
- Shift
- Monitor
- Working Memory
- Plan/Organize
- Org. Of Material
- Task Completion
- BRI
- MI
- GEC

Legend:
- Pre-Tx
- Post-TX
Pre- to Post-Treatment Changes on the Parent Report BRIEF (Improvements in Planning and Organizing)
Improvements in Goal Attainment Scaling

- +1 both noticed improvements in ability to remember multi-step directions and maintain focus
  - Sustained attention throughout individual tasks and for the overall 30 minute sessions
  - Mother shared that in the past week he had successfully picked up multiple items from store without a list or reminders
  - Also followed directions from a phone conversation on how to walk to aunt’s house in unfamiliar neighborhood after his ride did not show
A Treatment Failure: When Behavioral Issues Interfere with Treatment

• 15 year old with history of attention problems and difficulties with inhibition and judgment.
• Met older adolescents on the playground and conspired with them to steal his mother’s money and then claim that the house had been robbed.
• It was only when his story fell apart in the police station that his lies became apparent.
• Combination of poor judgment, impulsivity, few friendships, and poor social skills contributed to his problems with the law.
• Direct attention and metacognitive strategy training were not sufficient to address these issues.
Contrasting Symptom-Specific Approaches to Global Approaches Such as Online Problem Solving

• Family problem solving is a global approach to the issues following ABI that can be adapted to specific concerns
• Through successive iterations, family feedback has led us to incorporate more symptom or problem-specific content.
  • Anger management
  • Social problem solving and nonverbal communication
• The inclusion of supplemental sessions allows us to provide a tailored approach addressing less common concerns
• Supplemental sessions were generated based on parent and patient requests
  • Sleep
  • Memory
  • Seizures
• Problem solving is the beginning and not the end. Sometimes the result of problem solving is to seek a symptom-specific treatment or consultation (e.g. polysomnography).
Using the Family to Scaffold and Support Behavioral Changes

• Both Limond et al. and Beauchamp and Anderson models highlight the underlying role of the social environment and particularly the family in cognitive and social outcomes respectively.

• Given cognitive and self-awareness issues, which may contribute to adherence difficulties, family involvement may be essential for fully understanding how the injury affects every day functioning and in supporting plan implementation.

• Families can be “super models”, displaying desired behaviors and interactions or the therapeutic agent.
Symptom-Specific versus Holistic Interventions for Social Outcomes

**Emotion Recognition Training**
- Addresses deficits in emotion recognition that can disrupt social interactions.
- Target is improved accuracy of emotion recognition.

**Social Participation and Navigation**
- Addresses limited social participation through goal setting and a “peer” coach.
- Target is increased quality and quantity of social participation.
Modifying Emotion Perception
(Marcus Munafo, Ph.D.)

• Faces from a morph sequence presented in random order for 150 ms.

• Threshold assessed in initial phase, then feedback provided to modify this.
Modifying Emotion Perception

Judged ‘happy’ at baseline

Judged ‘angry’ at baseline

Judged ‘happy’ post-training

Judged ‘angry’ post-training
Components of Social Participation and Navigation Intervention (SPAN)

- Phone app to support goal setting and implementation of social participation goals
- Online modules with information/skills to support effective social interaction
- Peer coaching via facetime or skype (college students serve as coaches)
- Closed social networking site to allow interaction with other adolescents with TBI
Development Process

- Focus groups with stakeholder groups
  - Students with TBI
  - Parents of students with TBI
  - Healthy adolescents
  - Healthy college students
- Development of prototype app and modules
- Usability testing of app prototype
- Advisory board feedback
- Brief 4-week test of app with coaching support
- Further iterations prior to larger pilot trial
Take Home Messages from Focus Groups

• Adolescents with TBI are technologically savvy and use smartphone apps already
• Barriers to participation following TBI include too much work/too little time, lack of initiative, and inability to drive/get to places
• Healthy teens and college students face some of the same challenges to participation (too much work), but are better at identifying strategies to make sure they have fun activities planned
Adolescents with TBI indicated a desire to socially network with teens like themselves. Their parents thought that a Facebook-like site was important as well so their child would not feel alone. Teens wanted to have some say over who would be their peer coach including similar interests and background. Some debate about how much parents should be involved, but some consensus to keep them in the loop.
App Design

SPAN

Get out. Get social.

Get started!
I'm a teen
I'm a coach
Setting Social Participation Goals

My Social Participation Goals

What are activities or social participation goals that you would like to focus on?

- I want to do more activities with other teens
- Join an after school art program
- Hang out with friends

+ Add a goal

← Previous  Next →
Identifying Strengths

My Strengths

What are things about yourself that will help you reach your participation goals?

- Good sense of humor
- Friendly
- I'm strong

+ Add a strength
Identifying Challenges

My Challenges

What are things that might make it harder to reach your participation goals?

- Headaches
- Hard to make friends
- Unsupportive people
- Homework!

Add a challenge

Previous Next
Reaching Participation Goals

Create a Goal

What do you want to accomplish?

 Participate in an after school art class.

Goals are generally too big to work on all at once.

That's why next we're going to break down your big goal into smaller, more "do-able" steps.
Reaching Participation Goals: Concrete Steps

Create a Step

What is a specific action you can take to help you reach your goal?

Stop by art class to find out schedule.
Strategies for Achieving Your Goals
Central Question

• Can a global, downstream intervention like our social participation app improve social outcomes without addressing underlying skill deficits, like emotion recognition?
Deciding When to Use a Symptom-Specific Treatment versus Broader Intervention Approach

• Is there a narrow, well-defined problem (e.g., sleep)?
• Is behavioral and social functioning relatively intact?
  • If not, you probably need a multi-faceted intervention that incorporates support from everyday people in the child’s life
• Is the home environment able to support and promote intervention implementation?
• Do you have a good plan for translating gains made in treatment to everyday settings to promote generalization?
The Family’s Willingness and Ability to Engage in Multiple Sequential Treatments

• Barriers such as cost and time may limit the child and family’s willingness to participate in one tailored treatment after another.

• Youth with ABI typically didn’t want to do more than 10 sessions, especially if it involved repeated trips to the hospital.

• How can we sequence and deliver treatments to maximize quality of life?
Novel Approaches to Combining/Tailoring Interventions: Sequential, multiple assignment, randomized trial (SMART)

R = randomization; JASP-EMT = joint attention, symbolic play, enhanced milieu teaching; CORE-DTT = discrete trial training

First, all participants were randomized. Children received an intervention based either on child-led play (JASP-EMT) or adult-led instruction (CORE-DTT) as the first treatment to improve verbal capacity.

After six weeks, children’s response to treatment was assessed. All participants were re-randomized.

Responsive children were assigned to continue the same treatment or were assigned to their original treatment plus parent training. Non-responsive children were assigned to continue their first-line treatment or to receive both first-line treatments.
# Factorial Designs: An example with Attention/EF Issues

<table>
<thead>
<tr>
<th>Factor</th>
<th>Attention Training</th>
<th>Strategy/Problem Solving</th>
<th>Parenting Skills</th>
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<tbody>
<tr>
<td>Condition #</td>
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<td></td>
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</tr>
<tr>
<td>1 (control)</td>
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<td>no</td>
<td>no</td>
</tr>
<tr>
<td>2 (DAT)</td>
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<td>no</td>
<td>no</td>
</tr>
<tr>
<td>3 (AIM)</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>4 (Family PS)</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>5 (I-Interact)</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>6 (Van’t Hooft &amp; Lindahl Norberg)</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>7 (Teen-only PS)</td>
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<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>8 (AIM + TOPS)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>
Advantages of Factorial Designs

• Allow you to examine the value of different components of an intervention.
• Instead of conducting multiple separate studies can examine the comparative efficacy of various combinations of treatment in a single study.
• Doesn’t require huge sample sizes because you power your study for the contrast between two treatments (e.g., attention training versus no attention training).
Moving Forward

• Behavioral interventions for ABI are still in their infancy.
• Many questions remain to be answered regarding the nature, timing, and intensity of treatments.
• Problems following ABI are often life-long and treatment approaches need to take this into account.
• Families and other everyday people such as teachers and coaches may play an important role in delivering and reinforcing interventions.
Thank you!

Come visit!