Journal of the International Neuropsychological Society (2025), 1–9
doi:10.1017/S1355617725101161

INS Award Paper

Evaluating change in educators' brain injury knowledge and self-efficacy following completion of *TeachABI*

Sara A. Marshall[1], Kylie D. Mallory[1,2], Danielle DuPlessis[1,3], Christine C. Muscat[1,4], Andrea Hickling[1,2] and Shannon E. Scratch[1,4,5]

[1]Bloorview Research Institute, Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada, [2]Department of Occupational Science and Occupational Therapy, University of Toronto, Toronto, ON, Canada, [3]Department of Psychology, York University, Toronto, ON, Canada, [4]Rehabilitation Sciences Institute, University of Toronto, Toronto, ON, Canada and [5]Department of Paediatrics, University of Toronto, Toronto, ON, Canada

Abstract

Objective: Acquired Brain Injury (ABI) is a leading cause of childhood disability, yet educators report a gap in knowledge about supporting students with ABI when they return to school. We tested our *TeachABI* professional development module to examine how it impacted educators' ABI knowledge and self-efficacy for supporting students with ABI. **Method:** Fifty educators filled out questionnaires about their knowledge and self-efficacy at three time points: pre-module, post-module, and 60 days post-module. Score differences were examined across time. **Results:** Participants' ABI knowledge, subjective knowledge of the module learning objectives, and self-efficacy increased from pre- to post-module, and these gains were maintained at 60 days. **Conclusions:** This suggests that *TeachABI* is a tool for better equipping educators to support students with ABI.

Keywords: Brain injury; teacher training; return to school; inservice training; education-special; education

(Received 28 November 2024; final revision 7 May 2025; accepted 23 June 2025)

Statement of Research Significance

Research Question(s) or Topic(s):

Does completing the educational module, TeachABI, increase educators' knowledge of brain injury and confidence for supporting students with brain injury in the classroom?

Main Findings:

In a sample of 50 educators, completing *TeachABI* significantly increased both knowledge and confidence, and these gains were maintained after 60 days.

Study Contributions:

Educators internationally report a gap in their understanding of brain injury and do not feel equipped to help these students return to school. *TeachABI* fills this gap as a short, self-directed, and effective way to provide information about brain injury to these professionals.

Introduction

Acquired brain injury (ABI) is an umbrella term that refers to damage or injury to the brain that occurs after birth from a traumatic event (e.g., sports-related injury, motor vehicle collision) or nontraumatic (e.g., stroke, illness) event. ABIs can range in severity from mild (i.e., mild traumatic brain injury, also known as concussion) to severe, depending on the extent of brain damage. ABI is a leading cause of death and disability among children (Basso et al., 2006). Epidemiological studies find that 1.2 to 20% of youth will experience a traumatic brain injury (Haarbauer-Krupa et al., 2021; Ilie et al., 2013; Langer et al., 2020), which mirrors prevalence estimates of common neurodevelopmental disorders such as ADHD (Espinet et al., 2022), Autism Spectrum Disorder (Diallo et al., 2018; Zeidan et al., 2022), and learning disabilities (Fortes et al., 2016; Stegemann, 2016). This is significant because ABI can impact a child's cognition, physical abilities, behavior, and psychosocial well-being (Bennett et al., 2004; Hawley, 2004). The impacts of ABI are visible across different settings of a child's life, including home, social circles, and school.

At school, although each ABI results in a unique combination of symptoms, some students with ABI may resemble students in other exceptional groups. For example, students may have difficulties with attention, similar to students with Attention-Deficit/Hyperactivity Disorder (ADHD) (Emery et al., 2016), or poorer performance in academic skills such as reading or math, similar to students with a specific learning disorder (Vu et al., 2011). These similarities can result in misidentification of students

Corresponding author: Shannon E. Scratch; Email: sscratch@hollandbloorview.ca

Cite this article: Marshall S.A., Mallory K.D., DuPlessis D., Muscat C.C., Hickling A., & Scratch S.E. Evaluating change in educators' brain injury knowledge and self-efficacy following completion of *TeachABI*. *Journal of the International Neuropsychological Society*, 1–9, https://doi.org/10.1017/S1355617725101161

with ABI within education systems that do not explicitly recognize ABI in their special education policy, creating challenges in accessing proper supports (Zinga et al., 2005). This is especially important, because students with ABI also face challenges not common to other populations, including sudden onset, rapid changes in abilities, prior self-image as "normal," and medical complications (Campbell et al., 2022; CBIRT, n.d.; Minney et al., 2019). Recognition of both the common and unique challenges facing students with ABI is important, as students with ABI can experience academic underachievement, behavioral difficulties, frustration, and low self-esteem, requiring support as they return to school (Hawley, 2004; Vu et al., 2011).

Given the challenges of returning to school after an ABI, it is unfortunate that many teachers report feeling underprepared to support these students in their transition back to school and report gaps in their knowledge of ABI (Ernst et al., 2016; Farmer & Johnson-Gerard, 1997; Linden et al., 2013; McKinlay & Buck, 2019). In a local sample of educators in Ontario, Canada, 61% reported feeling "not" or "somewhat" comfortable assisting with the transition of students with ABI back to school (Stevens et al., 2021). These results are consistent with studies from the USA (Ernst et al., 2016; Farmer & Johnson-Gerard, 1997), Northern Ireland (Linden et al., 2013), and Victoria, Australia (McKinlay & Buck, 2019). Knowledge gaps, particularly regarding pediatric ABI, may contribute to teachers' lack of self-efficacy and ability to meaningfully include students with ABI in the classroom. In fact, Ontario educators have highlighted a lack of resources about ABI and supporting students with ABI in the classroom as a main factor contributing to their low preparedness to assist these students (Stevens et al., 2021). In literature examining inclusive education, teacher self-efficacy for inclusive education (i.e., the ability to plan and execute teaching practices that promote positive inclusion) has been found to strongly predict the actual use of inclusive practices (Sharma et al., 2021). Promisingly, professional development may increase teachers' self-efficacy for inclusion (Wray et al., 2022).

Educators' self-efficacy for supporting students with ABI may be related to their lack of training about ABI in their formal education or continuing professional development (Hartman et al., 2015). Ontario educators specifically suggested that a two-part course with an eLearning component would be a practical way to increase their knowledge of ABI and about supporting a student's transition back to school (Stevens et al., 2021). Importantly, educators requested that the online component include case studies and videos, that it be short (e.g., 25 minutes), and have flexibility for breaks (Stevens et al., 2021). Educators desired more information about brain injury, behavioral presentations, creating differentiated learning plans for students with ABI, and proactive strategies in the classroom. Finally, educators also valued taking a wholistic view of students' well-being and focusing on inclusive practices (Stevens et al., 2021).

With this interest from educators, our team conducted an environmental scan of the publicly available online resources accessible for educators to learn about supporting students with ABI (Saly et al., 2022). Although resources spanned different brain injuries, the majority addressed TBI and concussion. Despite finding 96 available resources, many of the resources were brief and not comprehensive. These resources would require educators to spend more time searching for each topic they might be interested in. Other resources were extremely long, likely introducing a barrier to educators who already have a high workload and may not have time to read or parse through such detailed materials (Karsenti & Collin, 2013; Saly et al., 2022). Furthermore, only one online module was found (Concussion Awareness Training Tool eLearning Module, https://cattonline.com/schoolprofessional-course/). This module, although relatively short, discusses only concussion and does not have information about the Ontario education system. There are two trainings that were not identified in the environmental scan, potentially due to limitations in the search terms or release date of the trainings: *HEADS UP to Schools* (https://www.train.org/cdctrain/course/1094770/details) and *In the Classroom after Concussion* (https://learn.cbirt.org/barin/users/login.php, Glang et al., 2019). However, these focus only on concussion and they were created for American educators.

In Canada, education is governed at the provincial, rather than national, level. This study took place in the province of Ontario, where the Ontario Ministry of Education oversees public education, including curricula, funding, policies and guidelines, and educational resources. There are three stages in the education system: early childhood (birth – 4 years), elementary school (kindergarten – grade 8), and secondary school (grade 9 – grade 12), and there are four types of public, government-funded school boards: English or French language, and Public or Catholic. All teachers must be registered with the Ontario College of Teachers, which is the regulatory body that sets standards for teacher training programs (People for Education, n.d.). Other professionals may also require licensure with their provincial regulatory body, for example, early childhood educators (https://www.college-ece.ca/) and psychologists (https://cpbao.ca/). Government-funded schools in Ontario prioritize the inclusion of students with exceptionalities into traditional classrooms, although some specialized programs and schools exist to support students with higher needs.

Ontario also has private schools, which follow the requirements in the *Education Act*, but operate independently of the Ministry of Education, as businesses or non-profit organizations (Ontario Ministry of Education, 2022). Private school teachers do not need to be members of the Ontario College of Teachers. Private schools may be open to students of all abilities or provide specialized programs for students with specific exceptionalities (Ontario Ministry of Education, 2022).

There is some policy about brain injury in Ontario schools. Specifically, in 2019, the Ontario Ministry of Education released Policy/Program Memorandum No. 158, requiring all school boards to have a policy on concussion safety and an annual concussion training for school staff (Ontario Ministry of Education, 2019). This policy focuses on the prevention and identification of concussions, as well as students' return-to-school plan following a concussion. Other types of ABI and aspects of supporting a student once they have returned to school are not covered.

Given the evidence of online training tools improving concussion knowledge (e.g., Glang et al., 2019; Nicol et al., 2023; Sadler et al., 2021), but the lack of ABI-specific, relatively short, comprehensive trainings, that are specific to Ontario's education system, our team developed the *TeachABI* online professional development module (see Methods for description of *TeachABI*).

To investigate whether *TeachABI* changes educators' understanding of ABI, we conducted a study with 50 educators, which is described herein. In this study, we examined if completion of *TeachABI* influenced educators' knowledge of ABI and self-efficacy supporting students with ABI in the classroom, and whether these changes were maintained two months after completing the module.

Methods

TeachABI – a professional development module for educators about ABI

TeachABI was iteratively designed by an interdisciplinary team, including clinicians, researchers, teachers, a knowledge translation specialist, and families and youth with lived experience of ABI (see Saly et al., 2023 for comprehensive development details). *TeachABI* is an independently completed online educational module that is self-paced and takes approximately 45 minutes to complete. It is designed for elementary school educators, and includes information about pediatric ABI, how symptoms might impact students at school, and recommendations for supporting students (Saly et al., 2023). *TeachABI* also includes links to external resources for educators seeking more information. The learning objectives are: (1) Define ABI; (2) Identify potential challenges for students with ABI in the classroom; (3) Discuss the importance of taking an individualized approach to supporting students with ABI; and, (4) Describe how to support a student with ABI in the Ontario education system. In previous work, we demonstrated that *TeachABI* was highly usable and teacher participants were satisfied with its content and functionality (Saly et al., 2023).

Design and participants

This study describes the quantitative outcomes of a multi-method pre-post evaluation of *TeachABI*'s impact on educators' knowledge and self-efficacy for supporting students with ABI in the classroom. Participants completed a series of questionnaires pre- (Time 1; T1), immediately post- (Time 2; T2), and two months after completing the *TeachABI* module (Time 3; T3). A subgroup of participants also participated in an interview at T2. The rich qualitative data from these interviews will be published in a separate manuscript, so they are not further described in this paper.

Participants were recruited through emails to schools in the Toronto District School Board (ethical approval file number: 4150113), emailing private schools, social media (e.g., Facebook, Twitter), and word of mouth.

To participate, individuals had to read English fluently and be either (1) working as an Ontario College of Teachers certified educator (e.g., classroom educator, special educator, principal, and occasional teacher) in an elementary school (government-funded or private), or (2) enrolled in an Ontario Teacher's College program leading to certification with the Ontario College of Teachers to work at the elementary school level. Consent was obtained from all participants prior to commencing the study. This study was completed in accordance with the Helsinki Declaration, and was approved by the Holland Bloorview Research Ethics Board (approval number 0414).

Questionnaires

Questionnaires are included in the supplemental materials.

ABI knowledge questionnaire

Given the lack of validated pediatric brain injury knowledge questionnaires specific to an educational context, the questionnaires used in this study were created based on *TeachABI* content to capture whether *TeachABI* is an effective learning tool. The questions were developed by an interdisciplinary team including a neuropsychologist, occupational therapist, and teacher, who agreed on their content and face validity. The questions were categorized as objective knowledge (asking about ABI facts), and subjective knowledge (asking participants to judge their own knowledge of the module learning objectives). The objective knowledge questions asked participants to respond on a five-point scale (false, probably false, don't know, probably true, true) to 23 statements about ABI. Examples include: "*When a child sustains an ABI, there is a better likelihood that they will make a full recovery compared to an adult*" and "*It can be challenging to provide support to students with ABI because their needs can change over time.*" Seven questions in this section were adapted from the Common Misconceptions about Traumatic Brain Injury Questionnaire (Farmer & Johnson-Gerard, 1997; Gouvier et al., 1988; Linden et al., 2013). The subjective knowledge questions asked participants to rate how strongly they agreed with their ability to accomplish each of the four learning objectives on a five-point Likert-type scale from strongly disagree to strongly agree. For example, "*I can define acquired brain injury.*"

ABI self-efficacy questionnaire

This questionnaire was created by the research team to understand participants' self-efficacy for supporting students with ABI. Participants rated their agreement to eight questions on a 5-point Likert-type scale from strongly disagree to strongly agree. For example, "*I feel confident about implementing strategies to support a student experiencing emotional difficulties after an ABI*" and "*I feel comfortable supporting students with ABI in my classroom.*"

Procedure

Participants met with a research assistant in a secure virtual meeting over Zoom (https://zoom.us). After providing informed consent, participants completed a set of questionnaires including demographics, background questions, and the ABI Knowledge and Self-Efficacy questionnaires (T1). After this, participants opened the *TeachABI* module and shared their screen with the research assistant. Participants were instructed to go through the module at their own pace, and explore any linked resources if interested. While the participants completed *TeachABI*, they shared their screen with the research assistant, but chose freely to keep their cameras and microphones on or off. As this was preliminary testing of *TeachABI*, a research assistant remained online while participants completed the module to answer questions or assist with online navigation difficulties. However, the research assistant had their camera and microphone off, so they could not be seen or heard by the participant. Immediately after completing the module, participants completed the same ABI Knowledge and Self-Efficacy questionnaires (T2). All participants received a follow-up email to complete the same questionnaires 60 days after completing *TeachABI* (T3).

Data analysis

All 50 participants completed their T3 follow-up, so the full sample was analyzed across all three time points. Data were analyzed to examine changes in ABI knowledge and self-efficacy over time. Many variables did not meet the assumption of normality, so we conducted non-parametric tests that do not make any distributional assumptions. Data were analyzed using R version 4.2.2 (R Core Team, 2022).

https://doi.org/10.1017/S1355617725101161 Published online by Cambridge University Press

Composite scores

Participants' objective knowledge was operationalized as the number of correct selections of true or false, with more points awarded for selecting true/false compared to selecting probably true/probably false (i.e., for a true response, false = 0, probably false = 1, not sure = 2, probably true = 3, true = 4; score; min = 0, max = 92), similar to previous scoring of the Common Misconceptions of Brain Injury questionnaire (e.g., Linden et al., 2013). For subjective knowledge, ratings on the Likert-type scale were summed (min = 0, max = 16). In the self-efficacy questionnaire, participant ratings on the Likert-type scale were summed (min = 8, max = 40). For all parts of the questionnaires, higher scores indicate a more positive performance. Any participants with missing data were excluded only for the incomplete scale (objective knowledge $n = 45$, subjective knowledge $n = 50$, self-efficacy $n = 47$).

Planned analyses

To detect differences over time for each scale, we conducted Friedman's test. If the test was significant, we conducted pairwise comparisons using Wilcoxon signed-rank tests with a Bonferroni-corrected alpha value ($\alpha = .016$) to examine which time points were significantly different.

Post-hoc exploratory analyses

To explore whether participants differentially responded to the module and the potential impact of participant characteristics on outcomes, we performed three post-hoc exploratory analyses. We recognize that our low sample size for some of these exploratory analyses and considered results with caution, as preliminary and secondary.

Do baseline knowledge and self-efficacy relate to change in outcomes?

To explore whether the module had the same impact for participants with high prior ABI knowledge and self-efficacy, we created change scores for each outcome variable (i.e., T2 score-T1 score, T3 score-T1 score). We performed linear regressions to predict the change score from participants' score at T1 (i.e., baseline value) for each outcome variable. We chose to use baseline scores rather than years of teaching or experience with ABI, because exploratory preliminary analyses showed that no demographic variables had a consistent relationship to the baseline of any of the three outcome variables. Furthermore, teachers' baseline knowledge and self-efficacy is not necessarily related to their demographic variables. For example, teachers with more years of experience may have less knowledge of ABI than teachers with fewer years of experience who have spent more time with students with ABI.

Do high baseline participants still benefit from the module?

To examine how the participants with the highest baseline scores changed over time, we separated participants who had scores one standard deviation above the mean at T1 for each outcome variable. We performed Friedman's test for each outcome variable to examine the change over time for these participants only. If the test was significant, we conducted pairwise comparisons using Wilcoxon signed-rank tests with a Bonferroni-corrected alpha value to examine which time points were significantly different.

Table 1. Participant demographic characteristics ($n = 50$)

Characteristic	n(%)
Gender	
Male	4 (8.0%)
Female	46 (92%)
Education	
Bachelor's	27 (55%)
Master's	22 (45%)
Missing	1 (2%)
Current roles in education	
Classroom Teacher	36 (72%)
Pre-Service Teacher	3 (6.0%)
Principal	2 (4.0%)
Special Educator	17 (34%)
Occasional Teacher	4 (8.0%)
Years of teaching	
0–4 years	11 (22%)
5–9 years	8 (16%)
10–19 years	11 (22%)
20+ years	15 (30%)
Missing	5 (10%)
School setting	
Public	34 (68%)
Private	13 (26%)
Catholic	3 (6%)
Special education experience	
Yes	29 (58%)
No	20 (40%)
Missing	1 (2%)
Additional special education training	
Yes	41 (82%)
No	9 (18%)
Additional ABI training	
Yes	3 (6%)
No	47 (94%)
Personal experience with ABI (self or known person)	
Yes	21 (42%)
No	20 (40%)
Unsure	9 (18%)

Do low baseline participants catch up to high baseline participants?

To examine the differences at T2 and at T3 between the high baseline (greater than one SD above the mean) and low baseline subgroups (greater than one SD below the mean), we used a nonparametric variant of the MANOVA (R package *npmv*; Burchett et al., 2017) with the between-subject factor of subgroups (high vs low baseline) and the multivariate outcomes of T2 and T3 scores.

Results

Participant demographics

Of the 50 Ontario educators, 92% were female, 55% had a bachelor's degree, and 52% had 10 or more years of experience. The majority of participants were classroom teachers (72%), followed by 34% identifying as special education teachers. Some participants identified multiple roles for themselves, showing the various responsibilities of educators. Although 58% had special education experience and 82% had special education training, only 6% reported receiving ABI-related training. See Table 1 for demographic information.

Change in knowledge and self-efficacy pre- and post-TeachABI

Objective ABI knowledge

We conducted Friedman's test to examine the differences in the statements about ABI participants correctly identified as true or

https://doi.org/10.1017/S1355617725101161 Published online by Cambridge University Press

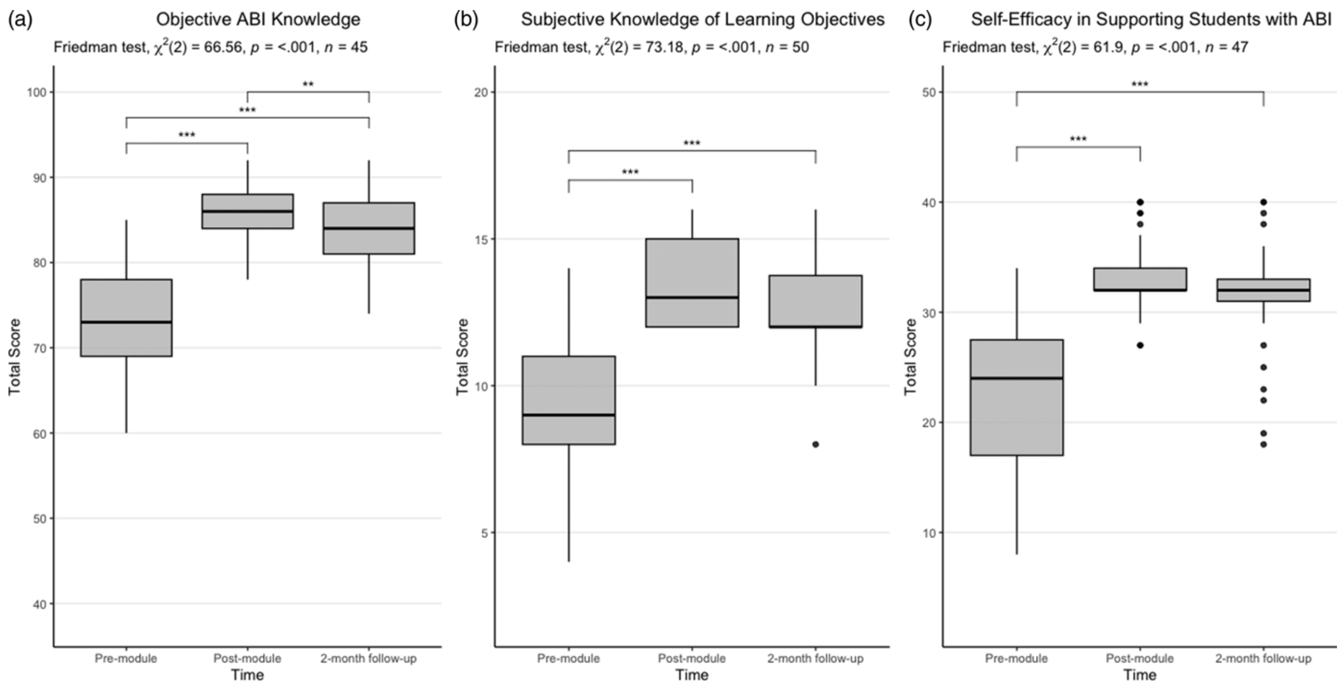

Figure 1. Changes in dependent variables across three time points. *Note:* Results of the Wilcoxon signed-rank tests, with Bonferroni-adjusted *p*-values. *$p < .05$, **$p < .01$, ***$p < .001$.

false across T1 (*Mdn* = 73, *IQR* = 69-78, *SE* = 0.94), T2 (*Mdn* = 86, *IQR* = 84-88, *SE* = 0.54), and T3 (*Mdn* = 84, *IQR* = 81-87, *SE* = 0.67). We found a statistically significant difference across time points, $C^2(2) = 66.56$, $p < .001$ (Figure 1A). Kendall's *W* revealed a large effect size (0.74). The Wilcoxon signed-rank tests used to conduct pairwise comparisons revealed a significant increase in knowledge scores from T1 to T2 ($Z = -5.78$, $p < .001$) and from T1 to T3 ($Z = -5.72$, $p < .001$). There was a significant decrease in knowledge scores between T2 and T3 ($Z = -2.97$, $p = .008$).

Subjective ABI knowledge

We conducted Friedman's test to examine the differences in participants' agreement with their abilities to accomplish the module learning objectives across T1 (*Mdn* = 9, *IQR* = 8 – 11, *SE* = 0.35), T2 (*Mdn* = 13, *IQR* = 12 – 15, *SE* = 0.22), and T3 (*Mdn* = 12, *IQR* = 12 – 13.75, *SE* = 0.21). We found a statistically significant difference across time points, $C^2(2) = 66.56$, $p < .001$ (Figure 1B). Kendall's *W* revealed a large effect size (0.73). The Wilcoxon signed-rank tests indicated a significant increase in knowledge scores from T1 to T2 ($Z = -5.95$, $p < .001$) and from T1 to T3 ($Z = -5.87$, $p < .001$). There was no significant difference in scores between T2 and T3 ($Z = -2.23$, $p = .07$).

Self-efficacy

We conducted Friedman's test to examine the differences in participants' self-efficacy for supporting students with ABI across T1 (*Mdn* = 24, *IQR* = 17 – 27.5, *SE* = 0.96), T2 (*Mdn* = 32, *IQR* = 32 – 34, *SE* = 0.45), and T3 (*Mdn* = 32, *IQR* = 31 – 33, *SE* = 0.65). We found a statistically significant difference across time points, $C^2(2) = 61.9$ $p < .001$ (Figure 1C). Kendall's *W* revealed a large effect size (0.66). The Wilcoxon signed-rank tests revealed a significant increase in self-efficacy scores from T1 to T2 ($Z = -5.84$, $p < .001$) and from T1 to T3 ($Z = -5.68$, $p < .001$). There was no significant difference in scores between T2 and T3 ($Z = -1.71$, $p = .09$).

Exploratory analyses: participant differences

Do baseline knowledge and self-efficacy relate to change in outcomes?

We performed linear regressions to examine the impact of baseline values on change in scores from T1 to T2 and T2 to T3. Predicting change in scores from T1 to T2, the model was statistically significant for objective knowledge ($R^2 = .69$, $F(1, 43) = 94.56$, $p < .001$), subjective knowledge ($R^2 = .68$, $F(1, 48) = 102.7$, $p < .001$), and self-efficacy ($R^2 = .81$, $F(1, 45) = 188.7$, $p < .001$). The models showed that as baseline scores increased, change in scores decreased. All three models were also significant for change in scores from T1 to T3 (objective knowledge: $R^2 = .59$, $F(1, 43) = 62.45$, $p < .001$; subjective knowledge: $R^2 = .67$, $F(1, 48) = 97.49$, $p < .001$; self-efficacy: $R^2 = .57$, $F(1, 45) = 60.9$, $p < .001$), showing that as baseline scores increased, change scores decreased. All coefficients and *p* values are summarized in Table 2.

Do high baseline participants still benefit from the module?

Friedman's test revealed significant differences in objective knowledge, with a large effect size, across the three time points for the high baseline group ($n = 7$; $C^2(2) = 8.54$, $p = .014$; Kendall's $W = 0.61$). However, after a Bonferroni correction (alpha level = .016), Wilcoxon signed-rank tests show no significant differences between T1 and T2 ($Z = -2.11$, $p = .035$), or T1 and T3 ($Z = -1.90$, $p = .058$).

The tests for both subjective knowledge (high baseline $n = 9$) and self-efficacy (high baseline $n = 7$) were not significant (subjective knowledge: $C^2(2) = 5.36$, $p = .068$; self-efficacy: $C^2(2) = 4.90$, $p = .086$), indicating that there were no significant

https://doi.org/10.1017/S1355617725101161 Published online by Cambridge University Press

Table 2. Regression analyses predicting change over time with baseline scores

	Change T1-T2				Change T1-T3			
Variable	*B*	*SE B*	*β*	*p*	*B*	*SE B*	*β*	*p*
Objective knowledge	−0.78	0.08	−0.829	< .001	−0.84	0.11	−0.77	< .001
Subjective knowledge	−0.94	0.09	−0.82	< .001	−0.84	0.09	−0.82	< .001
Self-efficacy	−0.94	0.07	−0.90	< .001	−0.72	0.09	−0.75	< .001

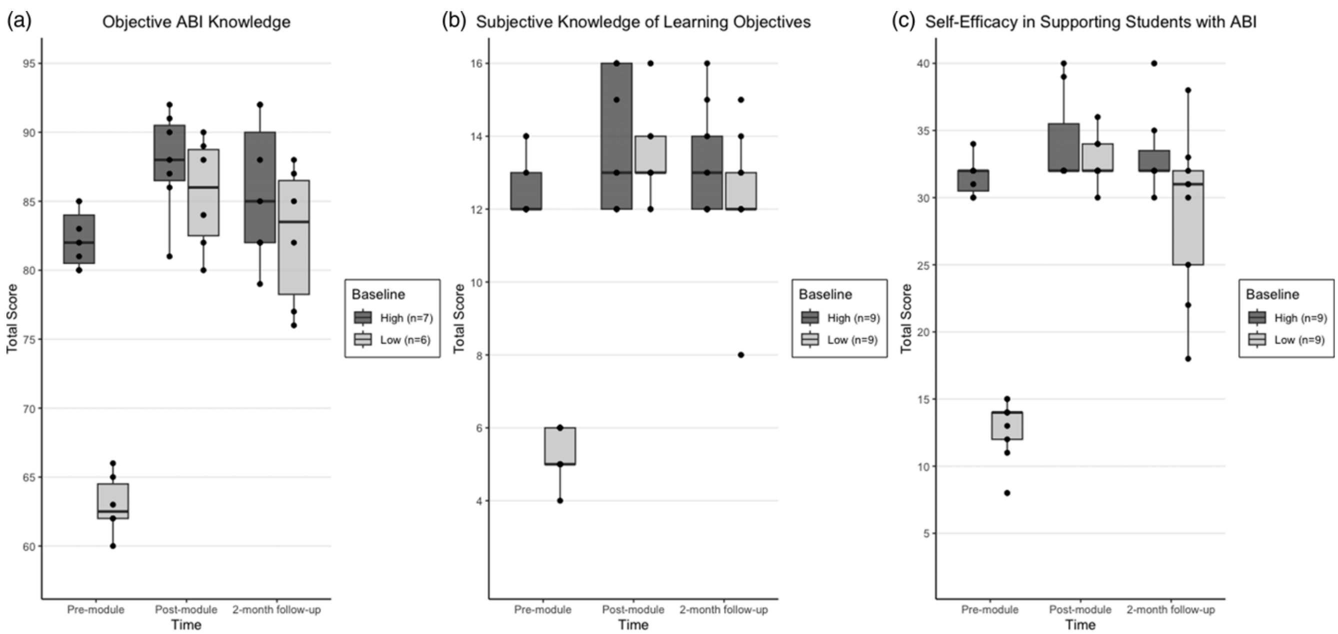

Figure 2. High- and low-baseline groups at three time points for each outcome variable.

differences in these scores across time for the participants with high baseline scores.

Do low baseline participants catch up to high baseline participants?

We performed a nonparametric MANOVA variant to examine the differences between the composite scores of high and low baseline groups at both T2 and T3 on all three outcome variables. The test was not significant for objective knowledge (F (1.22, 13.33) = 1.02, p = .35), subjective knowledge (F (1.90, 30.40) = 0.36, p = .69), or self-efficacy (F (1.87, 25.58) = 1.68, p = .21). This suggests that the low baseline group had the same final scores on all three outcome variables as the high baseline group. See Figure 2 for the high and low baseline group scores across time points.

Discussion

This study examined preliminary evidence of the impact of a professional development module, *TeachABI*, on elementary school educators' knowledge of pediatric ABI and self-efficacy for supporting students with ABI in the classroom. For the whole sample, knowledge of pediatric ABI, knowledge of the module learning objectives, and self-efficacy increased from pre- to post-training, and the gains were maintained at 60 days post-training for two of three variables. Furthermore, exploratory analyses suggest that participants with a high baseline knowledge and self-efficacy did not experience significant change in scores from pre- to post-training, and that participants with a low baseline knowledge and self-efficacy had post-training scores equal to the participants with high baseline scores after *TeachABI*.

These preliminary results are promising, suggesting that *TeachABI* may be an effective way to teach educators about ABI and increase their self-efficacy for supporting these students in the classroom. This aligns with other research showing that short mild TBI education sessions, both in person and online, improve school staff knowledge of brain injury (Berz et al., 2022; Carzoo et al., 2015; Glang et al., 2019). Previously examined education sessions ranged from 30 minutes (Carzoo et al., 2015) to 6 hours (Glang et al., 2019), suggesting that *TeachABI* (approximately 45 minutes) is a relatively short training compared to other studied options. *TeachABI*'s length and flexibility are key features, as many Canadian educators report working more than 50 hours a week and doing approximately 13 hours of supplemental work at home (Duxbury & Higgins, 2013) and educators commonly feel that their workload is too high and they lack time for key job activities (Alberta Teachers' Association, 2012; Froese-Germain, 2014).

The gains in knowledge in our overall sample were significant, which is a positive outcome given the documented gap in educators' ABI knowledge (Ernst et al., 2016; McKinlay & Buck, 2019). The improvement in self-efficacy is also important, given that previous research shows this construct relates to teacher instructional behaviors, student motivation, student achievement, and teacher communication with students (Sharma & George,

https://doi.org/10.1017/S1355617725101161 Published online by Cambridge University Press

2016). Most relevantly, in the context of inclusive education, teacher self-efficacy relates to intentions to use, and actual use of, inclusive practices (De Neve et al., 2015; Kiel et al., 2020; Sharma et al., 2021).

These preliminary results are also promising considering the context of Ontario's emphasis on inclusive education. In Canada, most provincial education systems prioritize inclusion of students with special education needs in general classrooms (Jaber & Guenot, 2022). In Ontario, a school board's *Identification, Placement, and Review Committee*, which reviews and organizes special education supports, considers supporting a student in their general classroom before placing them in a special education classroom (Ontario Ministry of Education, 2023). The value of inclusion and individualizing education is also highlighted in the Ontario Ministry of Education's document for educators *Learning For All*, which has descriptions of Universal Design for Learning and Differentiated Instruction, pedagogical approaches designed to ensure learning for all students in a class taking into account individual needs and abilities (Ontario Ministry of Education, 2013). This inclusion focus suggests that both general and special educators in Ontario are likely familiar with accommodations they can provide to students and already have expertise in teaching students with diverse needs. Despite this systemic focus on inclusive practices in Ontario and our sample's common experience with special education, participants' knowledge and self-efficacy still increased following the module. This suggests that the module is helpful to educators with a wide range of special education experiences.

The exploratory analyses provide some potential nuance to the whole-sample findings. The high-baseline subgroup of participants did not show significant improvements in their knowledge or self-efficacy. However, their scores did show the same increasing trend as the whole sample and low-baseline group. Promisingly, the low-baseline subgroup scores increased enough to meet the scores of the high baseline subgroup at T2 and T3. Although these exploratory results need to be interpreted with caution due to the small sample sizes (n = 7–9), they may suggest that the module is better suited to people with less existing ABI knowledge, but that it brings their knowledge up to the same level as their peers.

This study of the training impact of the *TeachABI* professional development module preliminarily demonstrated that completing *TeachABI* increased educators' knowledge of pediatric ABI and self-efficacy supporting students with ABI. However, our exploratory analyses showed that a subgroup of participants with low baseline scores on the three questionnaires may benefit more, although further subgroup analysis with a larger sample would confirm this relationship. This warrants further investigation using the qualitative interview data to explore whether high-baseline educators still expressed that the module is valuable to them. Overall, our study suggests that *TeachABI* is a short, beneficial training to increase Ontario educators' knowledge of pediatric ABI and potential strategies to support students in the classroom.

Limitations

This study was limited by a few factors. First, there was no control group. This limits the understanding of whether *TeachABI* offers benefits over the current information accessible to educators. Future studies will include a control intervention to further explore the impact of *TeachABI*. Although we strived for a diverse sample of educators, our sample had a slight overrepresentation of women (92%) relative to the percentage of Canadian educators who are women (84%; Government of Canada, 2018). Our sample was also unevenly distributed, with a majority of participants with special education training or experience, experience with ABI, and over 5 years of teaching experience. Although in some ways this is a strength, showing the impact of the module on an expert sample, it is not necessarily representative of all Ontario educators.

Furthermore, since participants self-selected to participate, our sample may have been more interested in learning about ABI than the general population of educators. Participants' engagement with *TeachABI* may have been influenced by the presence of a research assistant, by motivating them to focus. However, it is also possible that educators may have had more technical issues, and therefore learned less, if a research assistant were not present to help. Since the study aimed to examine how *TeachABI* impacts educator knowledge and self-efficacy, and module usability was previously explored (Saly et al., 2023), usability was not considered a key variable. The current study also did not record participant's module completion time, preventing analysis of how time of engagement with the module may have impacted learning.

Although some validated measure questions were used, the majority of survey questions were written by the research team due to the lack of validated questionnaires with relevance to ABI in the education sector. Furthermore, the psychometric properties were not explored, which may limit interpretation of the questionnaire. Future research should use or adapt previously validated measures of knowledge and self-efficacy. Finally, although there is a theoretical importance for increasing knowledge and self-efficacy of educators, our questionnaires cannot inform us of whether these changes influence teaching practices or student experiences.

Next steps

The quantitative data collected in this study captures educators' improvements in knowledge and self-efficacy following *TeachABI*. We plan to analyze the qualitative interview data to explore participants' experiences with the module and how they feel it is applicable to their teaching. Next steps in this research program include testing the module with a larger, more diverse sample of educators, with the addition of an information-only control group, as well as exploring implementation pathways in schools.

Conclusion

A student's return-to-school after ABI can be difficult due to the challenges they face after injury. We developed *TeachABI* to help prepare educators to support students with ABI in the classroom. Results of this study show that *TeachABI* improves educator knowledge of ABI and self-efficacy for supporting students with ABI. With improved educator training, we hope to improve the return-to-school experience for students with ABI.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/S1355617725101161.

Acknowledgements and Funding. The authors have no conflicts of interest to declare. Thank you to the participating educators who made this research possible. We would like to acknowledge the efforts of the members of the Neurehab Outcomes via Education and Learning (NOvEL) Lab Team (Bloorview Research Institute), specifically Lauren Saly, Brendan Lam, Alexa Irvin and Christine Provvidenza for their supports, as well as the TeachABI team, specifically Alicia Brown, Boey Ho, and Sarah Nauman. This work was supported by the Centre for Leadership at Holland Bloorview Kids Rehabilitation Hospital and the Social Sciences and Humanities Research Council (#430-2019-0714).

References

Alberta Teachers' Association(2012). *The new work of teaching: A case study of the worklife of calgary public teachers*. Alberta Teachers' Association. Available at https://legacy.teachers.ab.ca/SiteCollectionDocuments/ATA/Publications/Research/pd-86-23%20New%20Work%20of%20Teaching%20-%20Calgary.pdf

Basso, A., Previgliano, I., & Servadei, F. (2006). Traumatic brain injuries. In *Neurological Disorders: Public Health Challenges* (pp. 164–173). World Health Organization, https://www.who.int/publications-detail-redirect/9789241563369

Bennett, S., Good, D., Zinga, D., & Kumpf, J. (2004). Children with acquired brain injury: A silent voice in the Ontario school system. *Exceptionality Education Canada*, *14*(1), 115–131.

Berz, K., Rhine, T., Pomerantz, W. J., Zhang, Y., Loftus, K., Lyons, S., & Logan, K. (2022). An intervention to improve knowledge and increase comfort of concussion management among school medical staff. *Nurse Education Today*, *109*, 105247.

Burchett, W. W., Ellis, A. R., Harrar, S. W., & Bathke, A. C. (2017). Nonparametric inference for multivariate data: The R package npmv. *Journal of Statistical Software*, *76*(4), 1–18.

Campbell, A., Plourde, V., Hartling, L., & Scott, S. D. (2022). You can't fix your brain": Exploring concussion experiences of children and parents. *Journal for Specialists in Pediatric Nursing*, *27*(1), e12357.

Carzoo, S. A., Young, J. A., Pommering, T. L., & Cuff, S. C. (2015). An evaluation of secondary school educators' knowledge of academic concussion management before and after a didactic presentation. *Athletic Training & Sports Health Care*, *7*(4), 144–149.

[CBIRT] Center on Brain Injury Research and Training. (n.d.). *TBI compared to other disabilities*. University of Oregon. *Available at* https://cbirt.org/sites/cbirt.org/files/resources/tbi_compare_chart.pdf

De Neve, D., Devos, G., & Tuytens, M. (2015). The importance of job resources and self-efficacy for beginning teachers' professional learning in differentiated instruction. *Teaching and Teacher Education*, *47*, 30–41.

Diallo, F. B., Fombonne, É., Kisely, S., Rochette, L., Vasiliadis, H.-M., Vanasse, A., Noiseux, M., Pelletier, É., Renaud, J., St-Laurent, D., & Lesage, A. (2018). Prevalence and correlates of autism spectrum disorders in quebec: Prévalence et corrélats des troubles du spectre de l'autisme au Québec. *The Canadian Journal of Psychiatry*, *63*(4), 231–239.

Duxbury, L., & Higgins, C. (2013). *The 2011/12 national study on balancing work, life, and caregivingin Canada: The situation for Alberta teachers*. Alberta Teachers Association. *Available at* https://legacy.teachers.ab.ca/Public%20Education/EducationResearch/Pages/ResearchPublications.aspx

Emery, C. A., Barlow, K. M., Brooks, B. L., Max, J. E., Villavicencio-Requis, A., Gnanakumar, V., Robertson, H. L., Schneider, K., & Yeates, K. O. (2016). A systematic review of psychiatric, psychological, and behavioural outcomes following mild traumatic brain injury in children and adolescents. *The Canadian Journal of Psychiatry*, *61*(5), 259–269.

Ernst, W. J., Gallo, A. B., Sellers, A. L., Mulrine, J., MacNamara, L., Abrahamson, A., & Kneavel, M. (2016). Knowledge of traumatic brain injury among educators. *Exceptionality*, *24*(2), 123–136.

Espinet, S. D., Graziosi, G., Toplak, M. E., Hesson, J., & Minhas, P. (2022). A review of Canadian diagnosed ADHD prevalence and incidence estimates published in the past decade. *Brain Sciences*, *12*(8), 1051Article 8.

Farmer, J. E., & Johnson-Gerard, M. (1997). Misconceptions about traumatic brain injury among educators and rehabilitation staff: A comparative study. *Rehabilitation Psychology*, *42*(4), 273–286.

Fortes, I. S., Paula, C. S., Oliveira, M. C., Bordin, I. A., de Jesus Mari, J., & Rohde, L. A. (2016). A cross-sectional study to assess the prevalence of DSM-5 specific learning disorders in representative school samples from the second to sixth grade in Brazil. *European Child & Adolescent Psychiatry*, *25*(2), 195–207.

Froese-Germain, B. (2014). *Work-life balance and the Canadian teaching profession*. Canadian Teachers' Federation. https://eric.ed.gov/?id=ED546884

Glang, A. E., McCart, M., Slocumb, J., Gau, J. M., Davies, S. C., Gomez, D., & Beck, L. (2019). Preliminary efficacy of online traumatic brain injury professional development for educators: An exploratory randomized clinical trial. *The Journal of Head Trauma Rehabilitation*, *34*(2), 77–86.

Gouvier, W. D., Prestholdt, P. H., & Warner, M. S. (1988). A survey of common misconceptions about head injury and recovery. *Archives of Clinical Neuropsychology*, *3*(4), 331–343.

Government of Canada. (2018). *Portrait of Canada's labour force*. Government of Canada. https://www12.statcan.gc.ca/nhs-enm/2011/as-sa/99-012-x/99-012-x2011002-eng.cfm

Haarbauer-Krupa, J., Lebrun-Harris, L. A., Black, L. I., Veliz, P., Daugherty, J., Desrocher, R., Schulenberg, J., Pilkey, D., & Breiding, M. (2021). Comparing prevalence estimates of concussion/head injury in U.S. children and adolescents in national surveys. *Annals of Epidemiology*, *54*, 11–20.

Hartman, L. R., Duncanson, M., Farahat, S. M., & Lindsay, S. (2015). Clinician and educator experiences of facilitating students' transition back to school following acquired brain injury: A qualitative systematic review. *Brain Injury*, *29*(12), 1387–1399.

Hawley, C. A. (2004). Behaviour and school performance after brain injury. *Brain Injury*, *18*(7), 645–659.

Ilie, G., Boak, A., Adlaf, E. M., Asbridge, M., & Cusimano, M. D. (2013). Prevalence and correlates of traumatic brain injuries among adolescents. *JAMA*, *309*(24), 2550.

Jaber, L., & Guenot, B. (2022). The rise in demand for special education in Ontario, Canada: A focus on french-language schools. *Journal of Teaching and Learning*, *16*(1), 44–63.

Karsenti, T., & Collin, S. (2013). Why are new teachers leaving the profession? Results of a Canada-wide survey. *Journal of Education*, *3*(3), 141–149.

Kiel, E., Braun, A., Muckenthaler, M., Heimlich, U., & Weiss, S. (2020). Self-efficacy of teachers in inclusive classes. How do teachers with different self-efficacy beliefs differ in implementing inclusion? *European Journal of Special Needs Education*, *35*(3), 333–349.

Langer, L., Levy, C., & Bayley, M. (2020). Increasing incidence of concussion: True epidemic or better recognition? *The Journal of Head Trauma Rehabilitation*, *35*(1), E60–E66.

Linden, M. A., Braiden, H.-J., & Miller, S. (2013). Educational professionals' understanding of childhood traumatic brain injury. *Brain Injury*, *27*(1), 92–102.

McKinlay, A., & Buck, K. (2019). Misconceptions about traumatic brain injury among educators: Has anything changed over the last 20 years? *Disability and Rehabilitation*, *41*(12), 1419–1426.

Minney, M. J., Roberts, R. M., Mathias, J. L., Raftos, J., & Kochar, A. (2019). Service and support needs following pediatric brain injury: Perspectives of children with mild traumatic brain injury and their parents. *Brain Injury*, *33*(2), 168–182.

Nicol, B., Adhikari, S. P., Shwed, A., Ashton, S., Mriduraj, A., Mason, K., Gainforth, H. L., Babul, S., & van Donkelaar, P. (2023). The concussion awareness training tool for women's support workers improves knowledge of intimate partner violence-caused brain injury. *INQUIRY: The Journal of Health Care Organization, Provision, and Financing*, *60*, 00469580231169335.

Ontario Ministry of Education (2013). *Learning for all – a guide to effective assessment and instruction for all students, kindergarten to grade 12*. Ontario Ministry of Education. *Available at:* https://www.ontario.ca/page/learning-all-guide-effective-assessment-and-instruction-all-students-kindergarten-grade-12

Ontario Ministry of Education (2019). *Policy/Program Memorandum 158.* Kings Printer for Ontario. *Available at:* https://www.ontario.ca/document/education-ontario-policy-and-program-direction/policyprogram-memorandum-158

Ontario Ministry of Education (2022). *Private schools*. Government of Ontario. http://www.ontario.ca/page/private-schools-0

Ontario Ministry of Education (2023). *Identifying students with special education needs*. Ontario Ministry of Education. *Available at:* http://www.ontario.ca/page/identifying-students-special-education-needs

People for Education (n.d.). *Public education in Ontario*. People for education. *Available at:* https://peopleforeducation.ca/public-education-in-ontario/

R Core Team (2022). R: A language and environment for statistical computing (Version 4.2.2). [Computer software]. R Foundation for Statistical Computing. *Available at:* https://www.R-project.org/

Sadler, K., Turcotte, K., & Babul, S. (2021). Collaboration, training and resources to support school policy development and recovery from concussion. *Health Behavior and Policy Review*, *8*(3), 257–268.

Saly, L., Marshall, S. A., Mallory, K. D., Hunt, A. W., Kakonge, L., Provvidenza, C., Hickling, A., Stevens, S. A., Bennett, S., & Scratch, S. E. (2022). Pediatric acquired brain injury resources for educators: A multi-year scan of Canadian-relevant internet resources. *Brain Injury*, *37*(4), 1–15.

Saly, L., Provvidenza, C., Al-Hakeem, H., Hickling, A., Stevens, S., Kakonge, L., Hunt, A. W., Bennett, S., Martinussen, R., & Scratch, S. E. (2023). The teach-ABI professional development module for educators about pediatric acquired brain injury: Mixed method usability study. *JMIR Human Factors*, *10*, e43129.

Sharma, U., & George, S. (2016). Understanding teacher self-efficacy to teach in inclusive classrooms. In *Asia-Pacific Perspectives on Teacher Self-Efficacy* (pp. 37–51), Brill, https://doi.org/10.1163/9789463005210_004

Sharma, U., Sokal, L., Wang, M., & Loreman, T. (2021). Measuring the use of inclusive practices among pre-service educators: A multi-national study. *Teaching and Teacher Education*, *107*, 103506.

Stegemann, K. C. (2016). *Learning Disabilities in Canada*. Learning Disabilities.

Stevens, S. A., Provvidenza, C., Zheng, S., Agnihotri, S., Hunt, A., & Scratch, S. E. (2021). Understanding the needs of Ontario educators in supporting students with acquired brain injury in the classroom. *Journal of School Health*, *91*(4), 285–290.

Vu, J. A., Babikian, T., & Asarnow, R. F. (2011). Academic and language outcomes in children after traumatic brain injury: A meta-analysis. *Exceptional Children*, *77*(3), 263–281.

Wray, E., Sharma, U., & Subban, P. (2022). Factors influencing teacher self-efficacy for inclusive education: A systematic literature review. *Teaching and Teacher Education*, *117*, 103800.

Zeidan, J., Fombonne, E., Scorah, J., Ibrahim, A., Durkin, M. S., Saxena, S., Yusuf, A., Shih, A., & Elsabbagh, M. (2022). Global prevalence of autism: A systematic review update. *Autism Research*, *15*(5), 778–790.

Zinga, D., Bennett, S., Good, D., & Kumpf, J. (2005). Policy and practice: Acquired brain injury in Canadian educational systems. *Canadian Journal of Educational Administration and Policy*, *43*, 1–23.

Author bio. Dr Shannon Scratch is a Clinician Scientist at Holland Bloorview Kids Rehabilitation Hospital and Assistant Professor in the Department of Pediatrics and Rehabilitation Sciences Institute at the University of Toronto. She is a practicing Clinical Neuropsychologist and her emerging research program and hospital clinic are dedicated to youth experiencing prolonged symptoms postconcussion and ABI, and their caregivers and families. She holds foundation and tri-council funding and is especially interested in the development and testing of new interventions for these youth. She holds the Holland Family Professorship in Acquired Brain Injury and is the director of the Neurorehab Outcomes via Education and Learning (NOvEL) Lab. She is passionate about fostering youth and family engagement in research and is the co-Chair of the Research Family Engagement Committee at Holland Bloorview.