

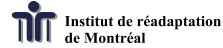
Les publications du **CRIR**

Volume 2, autumn 2005

**Interdisciplinary Research in Rehabilitation  
and Traumatic Brain Injury**  
New Theoretical and Clinical Perspectives

The publication of this book was supported by a grant from the *Comité directeur de la recherche en traumatologie* (Association des établissements de réadaptation en déficience physique du Québec, Association québécoise d'établissements de santé et de services sociaux, Société de l'assurance automobile du Québec — AERDPQ-AQESSS-SAAQ)

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Les Publications du CRIR

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ISBN: 2-9808464-2-2

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and Traumatic Brain Injury  
New Theoretical and Clinical Perspectives**

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## Message from the Scientific Directors

The Scientific Directors of CRIR are pleased to present the second volume in the *Publications du CRIR* series. The result of collaboration and fruitful synergy between researchers, clinicians, health care professionals and graduate students, this book deals with various biomedical and psychosocial aspects pertaining to the rehabilitation of individuals who have sustained a traumatic brain injury. It reflects the strong interest of researchers and clinical practitioners in the problems affecting this client group of the CRIR institutions, and it aims to fulfil one of the main goals of our research centre, namely, the transfer of knowledge to both the academic community and the various health care professionals. We hope that this book will provide something of interest for all readers, in the area of either basic or clinical research. We also hope that the ideas presented here will act as a spring-board for your own questioning, thereby advancing the knowledge and practice of rehabilitation.

The publication of this work has required the important contribution of the authors, along with the noteworthy efforts of the committee that oversaw the different stages of this process. We therefore wish to thank all the contributors, as well as the Editing Committee, chaired by Dr. Bernard Michallet, who brought this work to fruition.

We invite you to share your impressions of this second initiative of the *Publications du CRIR* with us, and we hope your reading will be rewarding.

EVA KEHAYIA, Ph.D.  
*Scientific Director*  
(*Psychosocial research*)

ROBERT FORGET, DPT, Ph.D.  
*Scientific Director*  
(*Biomedical research*)



## Introduction

The objective of the Centre for Interdisciplinary Research in Rehabilitation of Greater Montreal (CRIR) is the use of research—whether fundamental or applied, positivist or constructivist—in the development and definition of scientific bases and knowledge for effective and efficient rehabilitation. This is a reciprocal process, with issues arising in programs and questions raised by teams making clinical practice a guiding force behind scientific and research activities. CRIR also seeks to strengthen the partnership between universities and clinical communities and, through graduate programs and scientific activities, train the next generation of researchers and develop a research culture at rehabilitation institutions. A year ago, CRIR published its first collection, on the theme of stroke, in a volume of scientific articles, insights, and clinical discussions that was a tangible result of the above-stated objectives. At the time of its launch, the publications committee undertook to publish a second work, this one addressing traumatic brain injury (TBI). This condition, currently a major focus of research and discussion for our members, is a leading cause of morbidity in Canada and Quebec. Every year, some 18,000 people in Canada are admitted to hospital with a TBI. Constant advances in medical technology and prompt emergency care are increasing life expectancy for these individuals, who must learn to deal with the substantial impact of the injury on themselves and their families in the short, medium and long term. TBI causes major deficits that profoundly affect the social participation of affected individuals and their families for years, or even for life. The devastating results lead to increased risks of suicide, divorce, unemployment, social tension and addiction, as well as increased financial costs. This second volume is testimony to our efforts to respond as effectively as possible to the needs of TBI patients and those close to them.

The work is in two sections. Section one deals with moderate and severe TBI, and is divided into three parts. The first is devoted to current state of knowledge of certain aspects of this problem. In the first article, Lachapelle, Ptito and McKerral present their research results and current projects. Data from electrophysiology and functional brain imaging, when analyzed in terms of subjective symptoms, personal factors pre-dating the accident and sequelae measured by conventional methods like neuropsychological testing, enable early identification of the functional brain damage resulting from a TBI and of predictive markers for degree of overall recovery. This type of study could therefore help to lessen the impact of sequelae on the lives of patients, increase their autonomy, enhance their quality of life and, ultimately, reduce the socioeconomic impact of their deficits. As the article by Lefebvre, Pelchat, Gélinas, Michallet and Levert shows, families of TBI patients face a tough situation. The medical problem has major impacts in both

individual and family spheres: professional life is often abandoned or work schedules revamped to accommodate the person's needs, family relations are strained or severed, and contacts with the outside world (friends, leisure activities, and so on) are limited or non-existent. Physical and mental exhaustion is also a recurrent theme for people whose loved ones have sustained a TBI. Heightening these difficulties is the lack of follow-up and long-term support for families; more than ten years after the accident, they still need help. The results of this study lead to recommendations about resources to be provided for families, particularly in terms of clinical and organizational practices.

The second part comprises three articles dealing with intervention. Gagnon uses a clinical case to show how psychoanalytical psychotherapy may be included in rehabilitation intervention for people who have sustained a TBI. Psychoanalytical psychotherapy seeks a fuller understanding and complements neuropsychology by offering treatment options for certain individuals presenting complex psychological problems following a TBI. Because these problems may interfere with the overall rehabilitation process, it is important to take them into account when helping patients adapt to their neurological condition. Désilets, Lefebvre and Morissette review the literature on the impact of psychoactive substance abuse occurring with TBI. This dual diagnosis, frequently encountered in the clinical setting by professionals working with TBI patients and their families, requires a different approach for a clientele with specific needs. The literature suggests that the intervention should focus on the substance abuse and the TBI in an integrated manner and simultaneously, rather than sequentially as in the past. The simultaneous, integrated approach is designed to accurately document the consumption habits of TBI patients and to gear intervention toward promoting their participation in society. In addition, it aims to equip the individuals and their families with tools to devise their own solutions to this dual problem. Godbout explains that, of all the possible causes of vertigo or dizziness in people who have sustained a TBI, post-traumatic benign paroxysmal positional vertigo is particularly common and relatively hard to diagnose. Treatment is based on a thorough knowledge of the techniques involved and the three-dimensional anatomy of the peripheral vestibular system. It should also be suited to the patient's other medical conditions, such as anxiety, confusion or pain. For individuals to remain symptom-free in the long term, however, they must learn to maintain their progress and ensure they have sufficiently mastered their technique so that it remains effective over time.

Part three presents two innovative articles on organizational aspects of intervention with people who have sustained a TBI. Paquette explains that the usefulness of cognitive rehabilitation for these patients is now undisputed, although methods and procedures are still intuitive and arbitrary, in the absence of evidence-based clinical practice guidelines and scientific proof of efficacy. Until recently, people were unsure whether to offer rehabilitation services to an individual with cognitive problems. Today, cognitive rehabilitation is part of a cycle; the challenge involves



taking into account individual characteristics and determining the best procedure for enabling optimal function in daily life activities. The article discusses the need for practice standards in cognitive rehabilitation and the importance of the partnership between clinicians and researchers in achieving this. Swaine, Bottari, Crépeau, Demers, Désilets, Dutil and Guarna describe a questionnaire allowing people who have sustained a TBI to rate the rehabilitation services they receive throughout the care continuum. No valid, reliable tools for measuring this perception in this clientele were previously available. The questionnaire, developed by a multi-site, multidisciplinary team, could become a major tool for managers and clinicians, and, as a means of assessing all services, be part of the evaluations used during the accreditation process for adult TBI rehabilitation programs.

The second section is devoted to mild TBI (MTBI), currently a much discussed topic in the rehabilitation community. In the first part, Gagnon, Forget, Swaine and Friedman explain that the consequences of this type of injury are still debated. This was their main reason for examining balance skills and response times in a group of children over the 12 weeks following the accident in which they had sustained a mild TBI and comparing the results with those for a control group of uninjured children. Their study also sought to determine whether, 12 weeks after an MTBI, children maintain levels of physical activity, a perception of their athletic competences, and a level of self-efficacy comparable to those of the pre-injury period and the control group children. The study conducted by Nolin, Bernier, Mawn, Boutin and Lanctôt sought to determine whether MTBI symptoms are due to psychological, neurological or educational antecedents, or can be accounted for by the injury alone. It verified the impact of these factors on subjective symptoms and on the results of simple and complex attention and memory tests. No significant difference was found in the performance of participants who had sustained an MTBI based on the presence or absence of antecedents. On the other hand, only MTBI subjects with antecedents differentiated themselves from MTBI subjects without antecedents and control subjects on certain memory test variables.

The second part comprises two articles on intervention with MTBI patients. According to Guérin, Dominique, Léveillé, Kennepohl, Honoré, Brière and McKerral, the theoretical and clinical frameworks for intervention with this clientele need to be further evaluated and developed. The authors present a critical analysis of the recent literature on the prognostic factors for chronic post-concussion syndrome and return to work. The analysis highlights the multifactorial nature of MTBI and is in line with Kay's theory as well as with the authors' clinical experience in the last few years with this clientele. Their research and ideas have had a direct effect, enabling the development of clinical programming for MTBI patients who require services. Finally, the article by Banville and Majaron proposes a clinical intervention model with resilience as a conceptual framework. The model was developed from a critical review of scientific literature on MTBI and resilience, and proposes an ecosystemic intervention that prevents the long-term deteriora-

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tion of the patient's psychological condition by making use of the person's own individual and social strengths.

This volume is intended to bring clinical research and discussions on TBI conducted as part of CRIR activities to the attention of a wider audience. In preparing it, our main concern was to respond to the needs of everyone involved in rehabilitation: researchers and students, clinicians working with TBI patients, managers of rehabilitation institutions, and people with injuries and their families. It is hoped that the insights in the following pages will not only furnish some answers, but also provoke further questions and discussion and continue to drive rehabilitation research and intervention forward.

BERNARD MICHALLET, MOA, Ph.D.  
President  
CRIR Publications Committee

SECTION ONE

**Moderate to severe TBI**

PART I

**Current state of knowledge**

1. Visual information processing in adults with TBI  
*Julie Lachapelle, Alain Ptito, Michelle McKerral*
2. The long-term impact of TBI on the family  
*Hélène Lefebvre, Diane Pelchat, Isabelle Gélinas,  
Bernard Michallet, Marie-Josée Levert*



# Visual information processing in adults with traumatic brain injury

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**SUMMARY** – Individuals who have sustained a traumatic brain injury (TBI) are at high risk for sequelae that may affect their recovery and social participation. However, traditional methods of assessing brain damage do not always allow us to identify or predict the sequelae of a TBI (particularly if it is mild) and their impact on the patient's activities and lifestyle. Methods for evaluating cerebral function, such as evoked potentials (EP), have been developed and refined in recent years. They may now enable us to measure precisely and objectively the functional deficits associated with the TBI (e.g. processing of complex information). This article presents the results of an electrophysiological study (i.e. EP) using visual stimuli ranging from the simplest to most complex (checkerboard pattern reversal, movement, segregation of textures and cognitive task) conducted on a population that had sustained a TBI (mild, moderate or severe), compared with a normal population. The results show that it is possible to differentiate between these two populations using inversion of stimuli, segregation of textures and cognitive EPs. Moreover, comparing individual clinical and electrophysiological data allows us to identify functional deficits for certain individuals with a mild TBI (MTBI), for example, that were not identified by other methods. A more detailed study with this type of protocol could thus provide us with a fuller understanding of the relationship between the severity of the TBI and the functional consequences.

**KEYWORDS** – traumatic brain injury, visual and cognitive evoked potentials, texture segregation, information processing

## Introduction

### *Mechanisms of injury*

Traumatic brain injury (TBI) is one of the foremost causes of brain damage in human beings.<sup>24</sup> More than half of the brain injury clientele are victims of road accidents. A TBI is usually, though not always, the result of a blow to the head that is hard enough to damage normal brain functioning.<sup>24</sup> The mechanisms whereby lesions are produced involve acceleration, deceleration and rotation, which cause microscopic damage to neurons, cerebral axons and circulation,<sup>25,10</sup> among others.

Acceleration-deceleration refers to the sudden change in direction of the brain, produced by coup contrecoup, i.e. the damage that may occur at the site of the impact or on the opposite side to the injury by the movement of the brain striking the bony wall, which may cause cerebral contusions.<sup>27,10</sup> Lesions may also be produced by rotational forces that stretch or distort brain matter.

These primary injury mechanisms may result in secondary reactions such as hematomas, increased intracranial pressure, or ischemic and hypoxic injury, damaging the neuronal tissue.<sup>9,23,30</sup>

### *Clinical assessment of brain damage*

Morphological damage resulting from a TBI is usually assessed using techniques like axial tomography (CT Scan) and magnetic resonance imaging (MRI).<sup>32</sup> These neuroradiology methods provide a sound evaluation of the cerebral structure, but do not allow for the assessment of functional sequelae resulting from the damage.<sup>25,27,28</sup> The functional techniques currently available—such as cerebral metabolism imaging (SPECT Scan), positron emission tomography (PET) or functional MRI (fMRI)—are very invasive, extremely costly, or only at the experimental stage. They are not currently used systematically for providing a diagnosis or prognosis.

Subtle brain deficits due to the above mechanisms of injury may be hard to assess objectively; certain functional deficits are also difficult to describe.<sup>23</sup> This makes it hard to determine the correlation between the location and the extent of the brain damage, the clinical findings and the functional impacts.<sup>23,30</sup> Now that milder TBIs are being more effectively detected and the survival rate after a more severe TBI has improved, it is essential to identify the presence, type and severity of functional deficits at an early stage, and to determine markers predicting the level of overall functional recovery.

### *Effects of TBI on visual system*

A TBI may have multiple consequences. In addition to sensory and motor sequelae, individuals who have sustained a TBI often have cognitive and behavioural deficits. Patients who have sustained a TBI are at high risk for visual deficits, due to the mechanisms of brain injury and the neuroanatomic organization of the visual system.<sup>11,8,26,28</sup>

From 50 to 90% of individuals who have sustained a TBI present permanent visual deficits of varying degrees as a result of their injury.<sup>12,8,26</sup> The visual system is made up of the most complex neuronal circuit of all the sensory systems. Moreover, the brain areas involved in information processing and visual perception are very extensive and take up more than half of the brain.<sup>16</sup> It is therefore hardly surprising that visual function is frequently affected by a TBI, which, as explained, causes diffuse brain damage.

According to the literature,<sup>6,29,7,3</sup> electrophysiological techniques (which measure the transmission of “electrical” information in the brain) may be used to study how information is processed by breaking operation down into stages. Visual stimuli of increasing complexity are used to evaluate the function of the different cerebral structures and how they interact with each other, which is not necessarily possible with other sensory modalities. The visual system is clearly an extremely useful source from which to obtain data on information processing deficits and their functional impacts following a TBI.

### *Evoked potentials*

Visual EPs are a preferred reliable method for non-invasive assessment of the quality of information processing by the brain. However, despite their potential, their efficacy as a diagnostic and prognostic tool has so far been limited as regards the TBI clientele.<sup>11</sup> The stimulation techniques used were not very specific and did not allow for a combined assessment of primary visual analysis capacity and capacity reflecting more integrative visual processing. Using simple to complex visual paradigms (e.g. checkerboard: primary visual evoked potential (VEP); motion or texture segregation: second-order VEPs; attention and decision processes: cognitive evoked potentials (CEPs)) to generate EPs could enable researchers to develop a sensitive and reliable method for evaluating functional problems following a TBI and for determining the prognosis for recovery. This in turn would allow for more precise targeting of the appropriate rehabilitation programs and improve the quality of life for affected individuals.

The purpose of this study was to evaluate, using primary and second-order VEPs and CEPs, the presence, type and severity of functional deficits with respect to visual information processing following TBIs of varying severity. We hypothesized that the more severe the TBI and its impacts, the higher the number of electrophysiology measurements affected or the more the measurements reflecting primary information processing would be affected.

### *Methodology*

Four types of EPs (inversion, motion, texture segregation, and cognitive – see Figure 1) were recorded in a mild or moderate TBI population and in a population of normal control subjects. The elements used to determine the severity of the TBI were those of the Quebec neurotraumatology services continuum

and based on the definition of the American Congress of Rehabilitation Medicine.<sup>1</sup>

TBI subjects were recruited from the TBI program at the Centre de réadaptation Lucie-Bruneau (CRLB) and control subjects were recruited through advertisements in the CRLB staff newsletter. Informed written consent was obtained from all subjects. An ophthalmologic examination was administered beforehand to screen out peripheral or developmental visual pathology, and any subjective symptomatology was described in detail for each subject. Before the recording session, the TBI subjects and the control subjects filled out the Rivermead Post Concussion Symptoms (PCS) questionnaire<sup>16</sup> and the Oxford Questionnaire (© Oxford Head Injury Service), providing information about capacity and daily life.

### *Electrophysiology recordings*

Recordings were made in the electrophysiology laboratory at the CRIR—CRLB. Stimuli were generated and data was collected using the EP2000-Freiburg Evoked Potentials System.<sup>2,4</sup> Subjects were asked to watch with both eyes a fixation point in the centre of the screen and name the numbers appearing there, in order to maintain a high attention level. The whole session (preparation and recording) lasted 60 minutes, including breaks to reduce visual fatigue.

Signals were recorded using a 6-electrode apparatus (positioned at Oz, O3, O4, Pz, Cz and Fz on the scalp) with grounding and reference electrodes on the earlobe and forehead.<sup>14</sup> The amplitude (wave size) was calculated in microvolts from the base line to the maximum (positive or negative) of the wave; the peak time was the time in milliseconds between the start of stimulation and the point of the maximum peak. For the primary, motion and cognitive VEPs, 100 repetitions were used; for the VEP in texture segregation, 40 repetitions were used. Electrophysiological recording procedures complied with the standards of the International Society for Clinical Electrophysiology of Vision (ISCEV).<sup>14</sup> The procedure for obtaining the texture segregation VEPs is described in more detail in our recent article in *Vision Research*.<sup>20</sup>

### *Stimuli*

Four types of VEPs were recorded, from the simplest to the most complex. The simplest stimulus used was a checkerboard comprised of squares with a visual angle of 0.2° or 0.8° and contrast set at 98% (see Figure 1a). The checkerboard pattern reversed (black to white and white to black) at a temporal frequency of 2Hz. For motion VEPs, the stimuli used were a target contracting or expanding at a temporal frequency of 1Hz (see Figure 1b). The components had a spatial frequency of 0.7° with 20% contrast.

Two conditions were used for the EPs in texture segregation. For the first, the stimulus was defined by the orientation of the components. It had 4 sub-stimuli: 2 were homogeneous (lines of 0.1° on a 45° angle) and 2 were textured (45° lines angled at 90° to each other) (see Figure 1c). For this condition, contrast was 90%



and shifts between the stimuli occurred at a temporal frequency of 1Hz. The second condition for stimulation, which was defined by the motion of the stimulus components, also comprised 4 sub-stimuli, 2 of them homogeneous (light-coloured squares of  $0.1^\circ$  on a dark background, all moving in the same direction) and 2 textured (half of the light squares moved, creating a checkerboard effect). For this second condition, there was 30% contrast and changes between the stimuli took place at a temporal frequency of 1Hz.

For the CEPs, the stimuli used were checkerboards with different spatial frequencies that appeared on screen for 0.3 seconds; the screen then went blank (gray background) for 1.7 seconds. A frequent stimulus appeared on the screen 80% of the time. This was a checkerboard with squares of  $0.5^\circ$  and 20% contrast (see Figure 1d). A rare stimulus appeared on screen 20% of the time. This was a checkerboard with  $1.5^\circ$  squares and 20% contrast. Subjects were instructed to press a button when the rare stimulus was present.

## Results

This section contains the results obtained on the various EPs. Figure 1 shows examples of EPs obtained in normal subjects and subjects who had sustained a

FIGURE 1

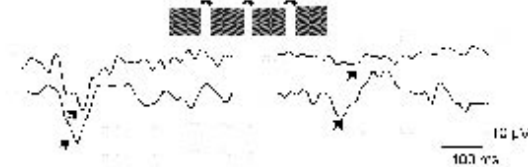
a) Reversal- $0.8^\circ$



b) Motion



c) Texture



d) Cognitive (P300)



## Legend

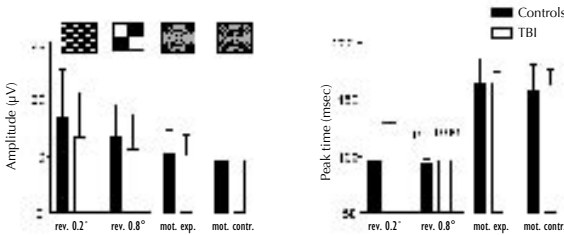
Examples of EPs for the 4 different recording conditions a) inversion, b) motion, c) texture segregation, d) cognitive, in normal and TBI subjects

TBI, with stimulation paradigms ranging from the simplest to the most complex: checkerboard pattern reversal (a), motion (b), texture segregation (c), cognitive task (d). As this figure shows, it was possible to record reproducible waves in different subjects. However, wave morphology in individuals who have sustained a TBI may vary from that recorded in the control population. Quantitative analyses these waves were used to determine whether these differences were reflected in amplitudes and peak times.

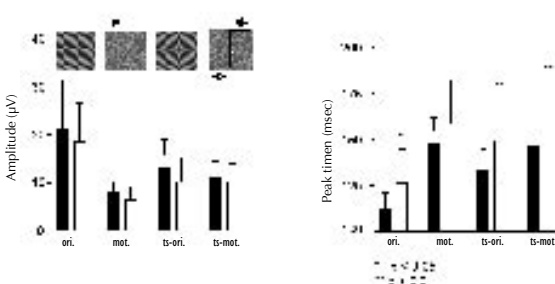
Figure 2 shows the means for responses to reversal, motion, texture and cognitive stimuli. Under a) are the results for the TBI populations in comparison to normal subjects for checkerboard pattern reversal, for the 2 spatial frequencies used, and for the expanding and contracting target motion stimuli. For these 4

FIGURE 2

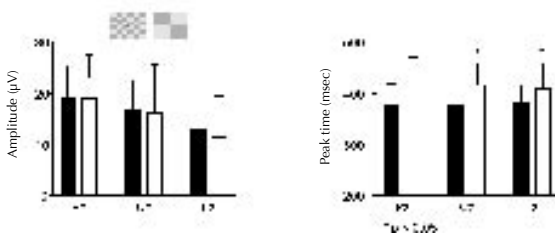
a) Reversal and motion



b) Texture



c) Cognitive (P300)

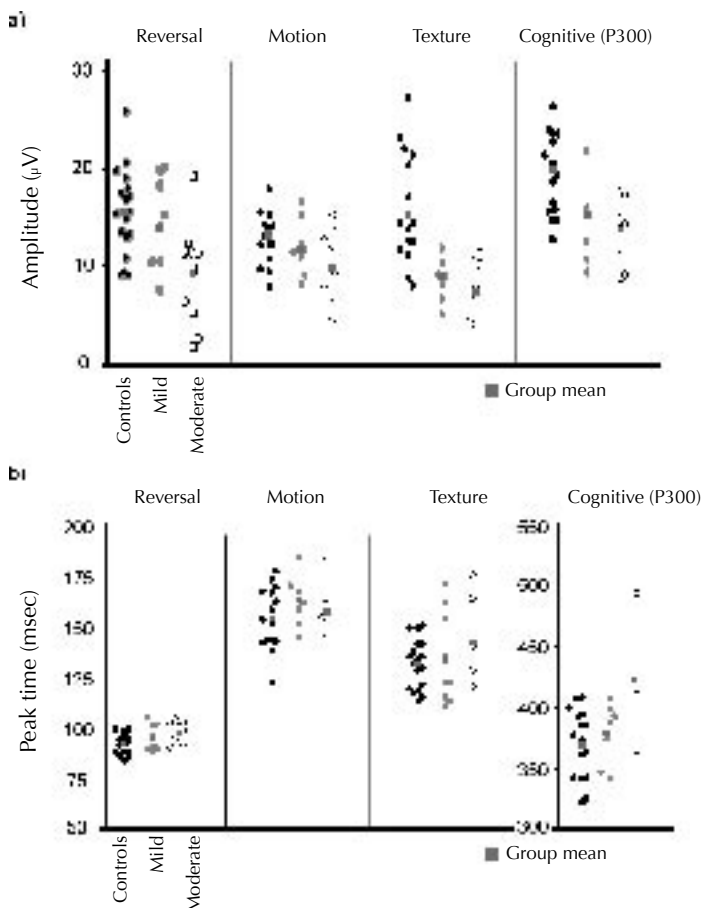


**Legend**

Mean results in normal subjects and TBI subjects for amplitude and peak time, for a) inversion and motion (b) texture segregation and (c) cognitive VEPs.

conditions, amplitude appeared to be diminished in TBI subjects, but this trend was not significant. However, for peak time, there was a significant increase for the 0.2° inversion condition and an almost significant increase for that of 0.8°. Expanding motion (exp. mot.) or contracting motion (contr. mot.) did not seem to distinguish between the 2 groups. Responses obtained on texture are shown in b), which shows the results for homogeneous stimuli (i.e. with no texture component) and stimuli defined by texture (orientation or motion). The texture-motion condition (ts.-mot.) did not appear to differentiate between control and TBI subjects, either in amplitude or peak time; this was consistent with the findings in a).

FIGURE 3



**Legend**

Individual results based on severity of TBI for a) amplitude and (b) peak time for inversion, motion, texture segregation and cognitive VEPs.

However, the homogeneous orientation condition (ori.) and the 2 texture segregation conditions (ts-ori. and ts-mot.) did differentiate between TBI subjects and normal subjects. In individuals who had sustained a TBI, peak time was significantly greater than in the normal population. The results for CEP conditions are shown in c). Here again, the amplitude of waves related to cognitive activity shows no difference between TBI subjects and normal individuals. However, peak time was significantly longer in TBI subjects for the Cz and Fz electrode positions.

Figure 3 shows the results with respect to amplitude (a) and peak time (b) for TBI subjects based on the severity of their injury, compared with normal subjects. Interestingly, though results were somewhat scattered for the different groups, the mean results were affected by severity. As the severity of the TBI increased, amplitude decreased and peak time increased; this was true for most of the conditions tested. The only component not following this rule was motion: for peak time, the moderate TBI group scored a slightly lower mean value than the mild TBI group.

Electrophysiological and clinical results for the 4 different TBI subjects are shown in Table 1. As this table shows, the severity of a TBI does not always correlate with its clinical profile. For example, subject 1 had sustained a mild TBI and had normal neuroradiology results. However, this individual presented visual symptoms; when these symptoms were assessed objectively with visual electrophysiology tests, 43% of parameters were found to be abnormal. In this case, conventional neuroradiology did not correlate with functional deficits. On the

TABLE 1  
**Sample comparisons between electrophysiological and clinical data for four TBI subjects**

Severity of TBI	Interval between TBI and evaluation	Abnormal electrophys. parameters	Neuroradio. results	Visual symptoms	Cognitive-behavioural problems
1. Mild	3 months	43%	Normal	Blurred vision (temporary)	Attention, information processing speed, organization, fatigue, anxiety
2. Mild	21 months	0%	Normal	None	Attention, visual memory
3. Moderate	31 months	88%	Frontoparietal subdural hematoma L	Visual fatigue	Attention, verbal and visual memory, visual synthesis
4. Moderate	7 months	12%	Slight lateral ventricular bleeding (occip.) R	None	Organization, fatigue, anxiety

other hand, subject 2, who was classified as a mild case, had a completely different clinical profile from subject 1. This individual did not complain of visual symptoms and the scan was negative, which correlated with the electrophysiological results, none of which were abnormal for this subject. Subject 3 had sustained a moderate TBI with visual symptomatology, as well as damage revealed by neuroradiology tests. Here the electrophysiological data correlated with severity and scan results, because 88% of the VEP results were affected. However, subject 4 had sustained a moderate TBI resulting in damage revealed by neuroradiology tests, but no visual problems; this was reflected in the electrophysiology, where barely 12% of the results were regarded as abnormal.

## Discussion

This study demonstrated the usefulness of EPs in evaluating increasing levels of complexity in visual information processing in adults who have sustained a TBI. By using visual paradigms ranging from the simple to the complex (checkerboard pattern reversal, motion, texture segregation, decision processes) to generate EPs, we were able to demonstrate the sensitivity of these techniques for evaluating functional visual deficits following a TBI and their promising potential for assessing an individual's degree of cerebral recovery.<sup>17,18,19,20,22</sup>

The results obtained in normal subjects and TBI subjects showed that the 2 populations may be differentiated using inversion stimuli, texture segregation stimuli, and CEPs. Specifically, the response to texture segregation, which occurs after the low level EPs (checkerboard pattern reversal) and before the CEPs in the information processing chain, appears particularly sensitive at identifying differences between the control groups and the TBI groups.<sup>17,20</sup> This data is interesting because the technique is relatively new and has not been used with a clinical population. It would be useful to add this technique to a battery of electrophysiological tests using stimuli of increasing complexity like the one used here, because this would provide an intermediate measurement between low-level VEPs and cognitive VEPs. Moreover, it has previously been demonstrated that the processing of more complex information is often affected following injury to the brain areas responsible for processing visual information. For example, second-order processing of visual information may be affected where first-order processing has remained intact after a stroke,<sup>31</sup> in developmental pathologies such as autism,<sup>5</sup> and in the normal aging process.<sup>13</sup> The VEP technique using texture segregation is thus doubly useful when dealing with TBI individuals.

We also analyzed the results for TBI subjects by severity, to see whether a group trend was visible. The mean results by degree of severity showed that individuals who had sustained a moderate TBI were more affected in terms of electrophysiology than subjects who had sustained a mild TBI; the latter were more affected than the control group in terms of both amplitude and peak time.

Finally, it is interesting to take a closer look at the individual results for TBI subjects. We were able to demonstrate that certain TBI subjects show a clear correlation between VEPs and CEPs and clinical data. However, in other subjects, this correlation was absent. For instance, electrophysiological parameters may be more or less affected than symptoms and clinical data suggest.<sup>21</sup> In other words, the patient's clinical presentation alone is not always a reliable indicator predictor of deficits in this clientele. It is therefore useful to have an alternative method for relating TBI severity with the functional consequences.

The data presented suggests that a more detailed study using an electrophysiological protocol like the one used here would help researchers to better understand the relationship between the severity of a TBI and its functional consequences. The different types of EPs may prove to be reliable markers of brain function and eventually be used systematically in the clinical setting. This would allow for more accurate decisions concerning the diagnosis, severity, prognosis and choice of necessary interventions. The authors are therefore pursuing this research, adding fMRI measures in order to examine the correlation between functional deficits measured with this tool and those identified with EPs. Correlational studies will also be conducted to determine the links between the techniques under study and the various factors that may affect recovery, which include subjective symptoms, TBI sequelae, and pre-injury personality traits (see also "Intervention based on the multifactorial nature of mild traumatic brain injury" in this volume).

### Conclusion

Functional deficits following a TBI may profoundly affect the rehabilitation and socio-professional reintegration of patients if they are not diagnosed promptly and if compensatory mechanisms are not put into place. In the medium and long term, the benefits from this type of research would be a better understanding and more accurate determination of intervention needs; this in turn would reduce the impact of sequelae on daily activities such as driving, studying, working and pursuing leisure activities. The individuals concerned would enjoy greater autonomy and better quality of life, and the socioeconomic impact of their deficits would be lessened.

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# The long-term impact of traumatic brain injury on the family

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**SUMMARY** – Traumatic brain injury (TBI) is a major source of morbidity in Canada and Quebec. Research shows that this health problem has an adverse long-term effect on people who have sustained a TBI and their families, increasing the risks of suicide, divorce, unemployment, social tension and drug addiction, as well as pushing up financial costs for the

- This study was funded by the Provincial Rehabilitation Research Network, the Ministère de la Santé et des Services sociaux and the Société de l'assurance automobile du Québec (REPAR, MSSS, SAAQ: 2002-2004), and the Groupe inter-réseaux de recherche sur l'adaptation de la famille et de son environnement (GIRAFE: 2004)

health care system. The results in this article are from a study documenting the point of view of individuals and their families with respect to the long-term repercussions of a TBI and the services received to foster the social participation of persons who have sustained a TBI. This part of the study was qualitative and used co-construction of reality from an interdisciplinary perspective. The data was collected from 22 individuals who had sustained a moderate or severe TBI 11 to 14 years earlier and 21 of their relatives, in individual, semi-guided interviews. The results indicate that family members find the situation involving the person who has sustained the TBI a difficult one, even more than 10 years after the injury. This health problem affects individuals and families profoundly. Family life is entirely focused on the brain-injured person. Looking after the person on a daily basis mobilizes the entourage, who invest a great deal of energy in the task. The difficulties appear to be aggravated by the lack of long-term follow-up and support for the family. More than 10 years after the injury, they still need support. The results of the study enabled certain recommendations to be formulated with respect to the resources offered to the family of an individual who has sustained a TBI.

**KEYWORDS** – social participation, traumatic brain injury, impact on the family, adjustment, services

### Introduction

Traumatic brain injury (TBI) is a major source of morbidity in Canada<sup>58</sup> and Quebec.<sup>57</sup> In Canada every year, approximately 18,000 persons are admitted to hospital due to a TBI.<sup>1</sup> Progress in advanced medical technologies and the speed with which emergency care is administered are increasing the life expectancy of people who have sustained a TBI.<sup>52,53,63</sup> Yet these individuals generally present major deficits that profoundly affect them and their families for years afterwards, or for life.<sup>9,18,19,24,30,56</sup> TBI increases the long-term risks of suicide, divorce, unemployment, social tension and drug addiction, and increases costs for the health care system.<sup>37,13,33,62</sup> However, in Quebec the long-term impacts on the families of people who have sustained a TBI are poorly documented.

This article presents the results of a study on the long-term impact of moderate or severe TBI on victims' families, as obtained in a qualitative study of long-term social participation among individuals who had sustained a moderate or severe TBI and the impact on families 10 to 14 years post injury.<sup>31</sup>

### Background

Regardless of the victim's age or status, the unexpected TBI disrupts the individual's environment and tests its capacity to adjust successfully to the stressful situation that ensues.<sup>54</sup> Clinical experience and research show that people who have sustained the TBI and their families must go through a major grieving process in order to adjust: they need to mourn what the person was before the injury in relation to family, social and professional life, and grieve for individual, marital,

parental and professional plans that have been shattered<sup>27</sup> The whole situation requires the TBI victims and their families to draw on their own resources and those of their environment.<sup>38,51</sup>

Research shows that many aspects of the individual and family experience of living with someone who has sustained a TBI make the adjustment process difficult. Both individual and family adjustment is often compromised by the collapse of the social network. A Canadian study involving 454 individuals, focusing on disability as experienced by people who had sustained a TBI and were living in the community, shows that this clientele constitutes a group of socially isolated individuals.<sup>10</sup> Colantonio *et al.*,<sup>7</sup> who conducted a study of 306 subjects who had experienced a moderate or severe TBI 14 years earlier, showed that they are more restricted with respect to certain activities, including going somewhere not within walking distance or managing money or purchases. In this study, 4 to 6% of the individuals were completely dependent for basic daily activities and personal care.

While this dependent state makes family adjustment more demanding, the problems families must cope with and the “burden” they shoulder are associated more with the behavioural and emotional problems of the victims than with their physical or cognitive deficits.<sup>16,17</sup> Behavioural and emotional sequelae hinder the adjustment process because physically, these individuals often look completely normal, and their deficits, which are often subtle, tend not to be noticeable. Acknowledgment by TBI victims of their own deficits is also a very important factor in the well-being of the families.<sup>16,17</sup>

Families also seem to have trouble taking on board the meaning of the health-related events and grasping how difficult it is for professionals to predict the outcome of interventions; this may jeopardize the establishment of mutual trust and delay the rehabilitation and adjustment process.<sup>29,32,47</sup> Life plans may have to be altered or re-thought. Research reports that families are relatively positive about the way they are functioning,<sup>17</sup> although the intensity of the “subjective burden”, distress and strain is usually moderate to severe. This can be explained by the fact that family members adjust themselves and re-shape their expectations of the person who has sustained a TBI and are comparatively content with the way their family functions, despite the feeling of a heavy “burden”. The stress as perceived by the family member closest to the person is a variable that appears to have a major influence following a TBI.<sup>17</sup> The severity of the injury or the time that has elapsed since it occurred are variables that do not necessarily have much effect on the strain that the family may experience; it is more the perception of the situation that affects the degree of stress felt.

Accordingly, the families of people who have sustained a TBI need more effective support from professionals in order to resume their normal lives. This support should extend beyond the rehabilitation, and may be required for life.<sup>4,6,17,16,23,26,35</sup> Professionals have trouble supporting families through the grieving process, which

can be multi-faceted and recur at different points, and offering them an intervention targeting their true needs, rather than focusing interventions solely on the TBI patient.<sup>17,16</sup> These facts are all the more important because family well-being seems to depend on the well-being of the victim, and vice versa.<sup>17</sup>

Recent literature shows that TBI brings not only negative impacts but may result in various positive effects for victims and their families. More and more studies are now focusing on coping strategies<sup>25,35</sup> and the skill of the people involved.<sup>2,25,35</sup> In a study of TBI patients and their families, Durgin<sup>15</sup> shows that they report changes for the better, such as a clearer sense of what is really important in life (meaning); more direct and frank communication between family members and friends; better communication with people with whom they had lost touch; greater sympathy for people struck by misfortune; an ability to overcome major personal challenges; assigning a more profound and more constructive meaning to life's problems in general; and a tendency to focus on what is important day to day, make plans for the future and assume responsibilities. Overall, research has pinpointed certain determinants of social participation in people who have sustained a TBI. However, they are poorly documented and need validating.

### Conceptual framework

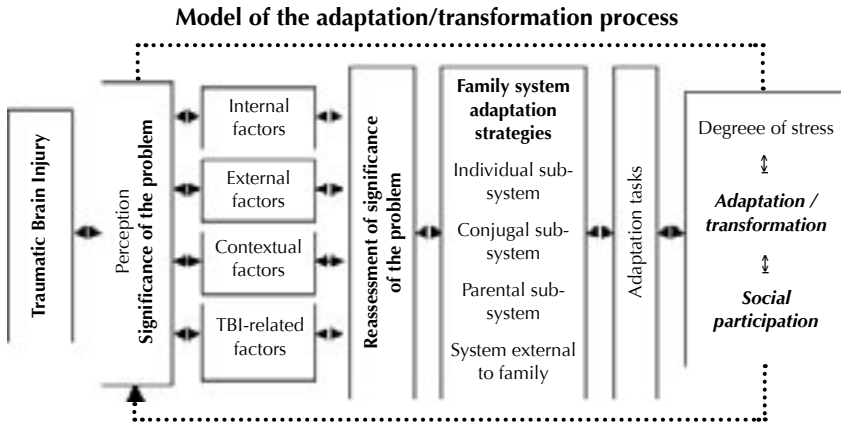
The theoretical frame of reference for this study was the model for the adaptation/transformation process.<sup>40,41,44,45,46</sup> Based on Lazarus's stress theory<sup>29</sup> and Boss's model for coping with family stress,<sup>3</sup> the basic premise of this model is that the intensity of the stress experienced by persons who have sustained a TBI and their families is determined by a cognitive assessment of the internal and external resources available to them for dealing with the situation and the significance of the event for the individual and the family. This initial perception is affected by *internal* factors (e.g. beliefs and values or the pre-injury personality), *external* factors (e.g. the pre-existing family dynamic and support from the entourage), *contextual* factors (e.g. the resources and services offered by the health care and social services system or the relationship with health professionals) and *TBI-related* factors (e.g. severity of the TBI, permanent or temporary nature of sequelae). Perception of the situation will influence the choice of strategies enabling or hampering the accomplishment of adjustment tasks such as getting used to the deficits caused by the TBI and changes in personality, reorganizing the family dynamic, and preserving significant relationships within the family and with the outside world. Resolving these adjustment tasks leads to individual and family adjustment and eventually, to more fulfilling social participation. With these concepts in mind the adaptation/transformation process is defined as follows:

Adaptation/transformation is the capacity of the person who sustained the injury and of his or her family to feel competent and confident using their own resources and knowledge to cope with daily life, be empowered, and work towards their new life goals.

Figure 1 shows the adaptation/transformation model.

The originality of the model of the adaptation/transformation process<sup>40,41,44,45,46</sup> is that it provides a clearer picture of the adaptation strategies and work that individuals who have sustained a TBI and their families have to accomplish in order to move forward with the adaptation/transformation process, based on their individual resources and those of the environment, the meaning they ascribe to the TBI, and the impact they perceive it as having on their lives.

FIGURE 1



## Methodology

### *Purpose and objectives*

The results presented in this article come from a study documenting the point of view of individuals and their families with respect to the long-term impacts of a TBI and the services they received that were designed to promote social participation of persons who have sustained a TBI.<sup>31</sup>

### *Study design*

This was a qualitative descriptive study. It used co-construction of reality in an interdisciplinary approach.<sup>36,60</sup> This method provided an opportunity to learn about, reflect on and examine the point of view of the different parties in order to understand the experience of individuals and families and the strategies used to deal with the problems involved. Reflection and dialogue enabled and supported the mobilization and interaction of the members of society involved in expressing ideas.<sup>49,50</sup> The study thus fell within the constructivist paradigm, with the co-construction of comments stemming from the interaction between the researchers and the participants consulted.<sup>21,20</sup> The data collection tools allowed for the construction in action of the meaning ascribed to the participants' experience and gave access to their *own experience*.<sup>22,20</sup> The individual interviews described the

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experience and expressed the opinions of the individuals who had sustained a TBI and their families.

#### Sample

The TBI patients and family members who took part in this study came from a sample set up 11-14 years earlier for “Projet trauma”,<sup>61</sup> assessing the overall con-

TABLE 1  
Sociodemographic characteristics of family members

Characteristics of family members	Percentage of sample			
Age of family members	• 18-29	4.8%	• 40-49	23.8%
	• 30-39	28.6%	• 50 and over	42.9%
Sex	• Male	42.9%	• Female	57.1%
Civil status	• Single	19.1%	• Married	52.4%
	• Common law spouse	23.8%	• Separated/divorced	4.8%
Education	• Elementary	9.5%	• College	47.6%
	• High school	23.8%	• University	19.1%
Ethnic origin	• Canadian	85.7%	• Portuguese	4.8%
	• Haitian	9.5%		
Chief occupation	• Working (+ than 20 hrs/wk)	52.4%	• Family responsibilities	4.8%
	• Working (- than 20 hrs/wk)	4.8%	• Retired	14.3%
	• Studying	14.3%	• No occupation	9.5%
Relationship with person who had sustained a TBI	• Father/Mother	28.6%	• Spouse	38.1%
	• Child	9.5%	• Friend	14.3%
	• Sibling	4.8%	• Ex-spouse	4.8%

TABLE 2  
Sociodemographic characteristics of persons who had sustained a TBI

Characteristics of persons	Percentage of sample			
Age	• 30-39	45.5%	• 50-59	9.0%
	• 40-49	36.4%	• 60 and over	9.0%
Sex	• Male	68.2%	• Female	31.8%
Occupation prior to TBI	• Paid work	54.5%	• Volunteer work	4.5%
	• Family responsibilities	27.3%	• No occupation	13.6%
Time elapsed since the accident	• 11 years	9.1%	• 13 years	36.4%
	• 12 years	27.3%	• 14 years	27.3%
Duration of coma	• 0-5 days	31.8%	• 16-20 days	9.1%
	• 6-10 days	36.4%	• 21 days and more	9.1%
	• 11-15 days	13.6%		
Duration of post-injury amnesia	• 0-10 days	13.6%	• 41-50 days	13.6%
	• 11-20 days	9.1%	• 100 days or more	13.6%
	• 21-30 days	27.3%	• Missing data	13.6%
	• 31-40 days	9.1%		
Type of compensation	• SAAQ	86.4%	• CSST	13.6%

sequences of a moderate or severe TBI. Recruitment of participants began in 1988 and ended in 1991 at a specialized trauma hospital in the Montreal area. The sample comprised 22 participants who had sustained a moderate or severe TBI on the Glasgow Coma Scale<sup>59</sup> and 21 family members. Tables 1 and 2 show the sociodemographic characteristics of the study participants.

### *Data collection*

The data was collected in individual interviews conducted simultaneously but in separate rooms with the person who had sustained a TBI and a family member. Interviews were conducted at home or at the research team's office, as preferred. Semi-structured interviews were chosen because they enabled the researcher to explore the different aspects of the participants' experience,<sup>11,34,50</sup> including construction in action of the meaning attributed to their experience and access to their own experience.<sup>22,20</sup> Audio recordings were made of the interviews, which lasted an average of 90 minutes. They were conducted with a guide containing open questions on social participation, the determinants that influenced it, and the profile of services during the first few months after the TBI and over the year prior to the interview.

### *Data analysis*

Analysis of the thematic content was based on the procedure used by Paterson, Thorne, Canam and Jillings.<sup>39</sup> An exhaustive summary of each interview was compiled using the audio recording. The initial analysis allowed themes to emerge and their meaning to be extracted. A second level of analysis was then used to identify convergences and divergences in what was said and identify common individual, familial and extra-familial threads. This analysis was approved by co-researchers on this study to ensure internal validity.

### *Criteria of scientificness*

To ensure methodological rigour, the qualitative aspect of this research was based on the following criteria:<sup>21,28</sup> credibility (similar to internal validity), assured by triangulation of the data obtained during regular validation of the reports of the work group meetings, summaries, and syntheses of handwritten notes and a log; transferability (similar to external validity), assured by a detailed description of the context of the study, so that readers may understand and predict a comparable situation in a comparable context; consistency (similar to reliability), achieved by recording every change in the research process in the log.

## **Results**

For approximately half of the individuals interviewed, the support of their families was a decisive factor in the quality of their social participation. However, provid-

ing this support is a demanding task for family members, who reported that TBI affected the different aspects of their lives (personal, familial and extra-familial). TBI results in a situation that is hard to endure on the personal level. The individual's professional life and occupations are profoundly affected and there are many causes for anxiety. More than 10 years after the accident, a number of relatives stated that they needed psychological support. The impact of the TBI is also felt in relations within the family and with their circle. These relations often become a source of conflict and are difficult to handle. The injury also has a detrimental effect on the social network.

### *Individual sub-system*

**IMPACT ON PROFESSIONAL LIFE.** For one third of the family members interviewed, the TBI situation had a major impact on their professional lives or principal occupations. When the person who had sustained a TBI returned home, these family members were obliged to reorganize their time. This frequently also meant they had to rethink their professional lives, take time off from work or give up a fulfilling job in order to look after the person. Regaining their former professional position was sometimes difficult or impossible. For example, an adolescent whose mother and father both sustained a TBI had to quit school in order to look after them. Other people managed to make arrangements (working from home or having their office close to the family home) that safeguarded their professional lives.

**WORRY.** The experience of slightly more than one third of the family members showed that TBI caused them a great deal of worry or even anxiety. The person's symptoms often stirred up intense fear. The depressive affects of the individual, combined with long-term antidepressant therapy, often made relatives fear the worst. In addition, the aggressiveness and impulsiveness of the person who had sustained a TBI worried them in terms of possible consequences such as legal disputes, conjugal violence or aggressiveness towards the people around them. Many family members were concerned about the future. As the years went by, they began to wonder who would look after and defend the rights of this person after they themselves had passed away.

**ADAPTATION STRATEGIES.** In order to adjust to living with the person who had sustained a TBI, family members developed various strategies to cope with the resulting changes. Some took refuge in travel, which gave them a chance to "*forget about everyday life*", while others kept a journal. Many family members reported that they now had a clearer vision of life and more authentic values. For others, the experience led to a renewal of religious faith. And for many people, it simply made them focus on the here and now: "*When things go well, that's fine; when they don't, I move onto something else.*"



**LONG TERM SUPPORT.** According to a number of family members, all these difficulties are aggravated by the lack of follow-up resources. The TBI is an ordeal for the family, and many people reported being exhausted and needing long-term psychological support: *“I don’t know whether I can continue to do both... working and going on... Maybe that’s it. I don’t know. Often I feel terrible, that’s for sure... like there’s something bothering me. I just don’t feel right.”* Psychological problems often appear in the form of psychosomatic symptoms such as hypertension or persistent digestive problems, which make day-to-day life difficult. The children of the person who has sustained a TBI are affected for many years and they may present developmental delays or emotional problems related to the stress from the accident. Family members felt they were left to manage alone and criticized the lack of resources offered. One family member said that the situation had a reciprocal effect on the relationship with the individual who had sustained a TBI: *“When one of us feels low, so does the other.”*

### *Family subsystem*

**IMPACT OF TBI ON FAMILY RELATIONS.** Most family members felt that the TBI had a profound impact on relations within the family. While family members sometimes had a positive attitude to this medical situation, its effects were more often detrimental to the family dynamic. Some people felt that the TBI experience had strengthened their marital or parental relationship. For some participants, the TBI actually improved communication between family members and led to more openness in the relationship. But 45% of family members felt that the TBI situation had a negative effect on the quality of relations between family members. Communication difficulties and certain behavioural sequelae, including aggressiveness and irritability in the person who had sustained the TBI, tended to be very hard on spouses and made life even more stressful. In some cases, these conflicts caused the couple to break up.

Judging by the experience of many family members, enormous energy was devoted to caring for the person who had sustained the TBI. The whole circle was involved (parents, siblings, spouse, friends). Many family members reported looking after all aspects of daily living for the person, including household chores, meals and personal hygiene. And many were constantly in attendance. From another angle, family members said they also took care of stimulating the person and providing them with the specific medical care they needed. In other words, the new life situation of the person who had sustained a TBI led family members to learn new skills. Among them were cognitive or language stimulation with memory games and naturopathic treatments. Providing the person with psychological support was another of their concerns. Most family members felt they were continuing the rehabilitation of the person who had sustained a TBI. One family member said *“With a TBI, you can’t talk about gains. You have to look at it as years of daily therapy, you have to believe in it, and it takes a long time.”*

*Extrafamilial subsystem*

**IMPACT ON RELATIONS WITH THE ENTOURAGE.** The TBI situation had an impact on family members' relations with their social circle. Social relations with friends of the couple or family were often called into question or broken off. Family members perceived TBI-related sequelae like aggressiveness, impulsiveness and compulsive behaviour as detrimental to relations with their circle. Other family members reported that it was hard for friends to understand and deal with outbursts of aggressiveness, which were often unpredictable, or alter their expectations of the person. All these factors meant that interpersonal relations were irreversibly affected, and breaking off these friendships often had repercussions on the quality of the family's social life and leisure activities. People also reported that recreational activities had been less frequent and of poorer quality since the accident; often this was still the case, even 10 years after the injury.

**Discussion**

The TBI situation has many long-term consequences for the family. One important point was the emotional burden still borne by family members 10 years after the injury. During the data collection process, most relatives were very emotional. The TBI had been, and after all this time still was, an event that shattered their lives. Bearing out the results of other studies, family members talked of their physical and emotional exhaustion, the heavier responsibilities assumed, the deterioration in the family's financial situation, or even the break-up of the family.<sup>5</sup> Many years later, the person who had sustained a TBI continued to be dependent on them. For certain family members, being so involved with the person resulted in ending a relationship with their spouse or friends. And most of them said they worried constantly about the person and the future. A number felt that the burden had rested mainly on them. This intensified stress in the family and wore out family members.<sup>12,15,35</sup>

*Critical review of the long-term adaptation of family members of the person who has sustained a TBI*

An increasing number of studies are now focusing on the coping or adjustment strategies put in place by family members.<sup>25,31,35</sup> In line with the literature, the results of this study showed that the immediate family employed a variety of strategies to deal with the situation. The return home usually involved reorganizing the daily routine to ensure someone was always with the person. Many family members reported that they had stopped working in order to take care of the person who had sustained the TBI; for others this strategy was not an option because they had to support the family financially. Some people changed their work location or hours. Others hired staff to clean the house. And others still decided to apply for a residential place for the person because they felt unable to

handle the situation and ensure the person made progress. Family members adapted to the person's changed behaviour and developed strategies for dealing with it. For example, they put up a reminder board to help the person get through the day or explained the situation to people in their circle (work colleagues, friends, family, etc.) so they would better understand the person with the injury. However, the aggressiveness of the person who had sustained the TBI seemed to be a major problem for a number of family members, instilling a climate of fear within the family. Moreover, behavioural sequelae seemed to be the hardest to manage for family members and created more problem situations than physical or cognitive deficits.<sup>4,6,31</sup> Strategies used by the family to deal with these difficulties were not usually adequate and many people felt the need for financial compensation programs that would enable them to take care of the person. The lack of follow-up and resources was often a factor in the deteriorating situation.

The statements made by family members were to varying degrees a reflection of the lack of long-term follow up provided by the health and social services system of 10 years ago. Most of them agreed that the care continuum as offered for the TBI clientele and their families more than 10 years ago was typified by a lack of services at the social integration phase. This impeded the adjustment process in the long term for this clientele. Family members also criticized the lack of information about problems that could develop over time. Certain relatives reported that difficulties only became apparent months, or even years, after the person came home: at the time, they had seemed to be "better". Despite all the work done by professionals and health organizations, family members complained about the services provided for the person who had sustained the TBI and for themselves. They said they had to take care of continuing the person's physical, cognitive, behavioural and social rehabilitation after they came home. This was very demanding. And the degree of dissatisfaction with their current situation was a clear sign that these compensatory mechanisms were simply not adequate.

More than 10 years after the injury, family members were trapped in a web of physical and emotional exhaustion without any chance of assistance from people who were experienced with such problems. They complained that they had been left to cope alone, without the resources to do so. In the past, services apparently focused too often on the functional limitations of the person who had sustained the TBI, overlooking the impact of the problem on the immediate family. These results are similar to those of many other studies, and clearly demonstrate that the family needs professional help and support for the long term.<sup>4,6,17,16,23,26,35</sup> And the results of this study, concurring as they do with the scientific literature, show that the social isolation endured by people who have sustained a TBI and the physical and emotional exhaustion of their families lead to higher risks of suicide, divorce, unemployment, drug dependency and social tension.<sup>62</sup>

### *Adaptation/transformation*

The study results also demonstrate a positive impact in the life of people who sustained a TBI and their families. As the literature shows, the TBI cloud does have a silver lining.<sup>14,15,31</sup> For some people, the TBI was the starting point for a positive transformation of their lives, and a number of people said they had approached life differently since the TBI. The remarks of family members interviewed as well as studies reveal that in the long term, daily life with the person who had sustained a TBI had resulted in the family learning new things and developing certain skills associated with the TBI and caring for the person on a day-to-day basis.<sup>2,25,35</sup>

Suffering is clearly an inherent part of the grieving process, but it is not the whole story.<sup>44,45</sup> With the TBI experience comes the potential for learning and personal growth.<sup>48,43,55</sup> In some cases, adapting to the medical problem also involved a change in terms of values, beliefs and knowledge for each family member, which in turn had a ripple effect on the family dynamic. Pelchat and Lefebvre<sup>42,44,45</sup> identified another stage in the process of adjusting to the medical problem: transformation. In practice, families do adapt, are transformed and learn to live with the difference; they develop strategies to address the needs of the whole family, and find fulfilment as a result of the health problem. This growth enables them to build new life projects for every aspect of their lives, on the individual, spousal, parental and extrafamilial levels.

Transformation requires constructing a positive meaning for the event as part of the adaptation process. This is where the resilience of family members comes in.<sup>8</sup> Resilience is a dynamic process developed through individual and family experiences. Family resilience is defined as the capacity of all members of the family to look after themselves, be proactive, and become involved in the individual and family transformation process by coping with the stressful situation, giving it a positive meaning, and enabling each person to find a new personal equilibrium in order to take part in the renewal of family well-being.<sup>44</sup> This individual and family transformation process is supported by protective factors or impeded by risk factors in both the individual and the environment.

However, for transformation to be achieved through adaptation to the medical situation, people who have sustained a TBI and their families need to be supported through the process by health professionals and to receive the benefit of “protective” services and resources.

### **Recommendations**

The results of this research shed light on the consequences of the shortcomings in the continuum of care for the TBI clientele 10 years ago. Based on these findings, it is possible to formulate recommendations for improving the quality of care and services today, particularly as regards support for the family. The well-being of the family seems to be nourished by that of the person who has sustained the TBI, and

vice versa. Supporting the family ensures that the person functions at the optimum level.<sup>17</sup> Consequently, we should:

- focus intervention programs more on the real needs of the person and the family in order to increase their involvement in the rehabilitation process;
- provide the family with full information about the short-, medium- and long-term evolution of this medical problem and the demands it makes on daily life, before the person goes home. The family would then be prepared for the changes and long-term impact of the TBI on the different aspects of their lives and be able to evaluate the quality of informal care they receive;
- provide long-term psychological follow-up for family members, to support them as they go through this affectively and emotionally demanding experience. Although long-term follow-up of the person who has sustained a TBI should free family members from heavy responsibilities, the fact is that the TBI life situation remains demanding day to day, even more than 10 years later. As with persons who have sustained a TBI, follow-up of family members should be initiated by the health care network, to enable socially isolated families to benefit from the resources available;
- review the orientation of rehabilitation programs to promote optimum use of resources in the person's environment. New intervention methods meshing with community resources should be developed to support the gradual adaptation of people who have sustained a TBI and their families.

## **Conclusion**

The remarks by people who had sustained a TBI and their families shed light on the long term impacts of this medical problem on the victim's entourage. In particular, family members require long term follow-up to enable them to adapt more successfully to the TBI. At the moment, family members endeavour to make up for the lack of resources by taking on the person's long-term physical, cognitive, psychological and social rehabilitation themselves. This is very demanding, however; witness the physical and emotional exhaustion underlying their remarks. It remains to be seen whether the situation today is any better in terms of care and services for this clientele than it was 10 years ago. It is to be hoped that the efforts of the various clinicians and health organizations over the last few years have had a concrete impact on the availability of services and resources offered on a long-term basis to the families of people who have sustained a TBI. The impact of current support policies should be reassessed, focusing on ways to complement the services provided by professionals and health organizations as well as the efforts of people who have sustained a TBI and their families, from the very start of the continuum of care.

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**PART II**

**Intervention**

**1. Psychoanalytic psychotherapy following  
traumatic brain injury: A clinical case**  
*Jean R. Gagnon*

**2. Traumatic brain injury and psychoactive substance abuse**  
*Monique Désilets, Hélène Lefebvre, Pauline Morissette*

**3. Benign paroxysmal positional vertigo and traumatic brain injury:  
Specific evaluation and treatment**  
*Alain Godbout*



# Psychoanalytic psychotherapy following traumatic brain injury: A clinical case

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**SUMMARY** – A clinical case is presented to illustrate how psychoanalytic psychotherapy can play a major role in the rehabilitation of traumatic brain injury (TBI) patients and complement the neuropsychological approach in terms of conceptualization and treatment, particularly for individuals presenting complex psychological reactions that may interfere with the rehabilitation process.

**KEYWORDS** – traumatic brain injury, psychoanalytic psychotherapy

## Introduction

In addition to the objective sequelae of traumatic brain injury (TBI), which have a direct and measurable effect on sensorimotor, cognitive and behavioural function, the injury has an impact on the person's subjective experience.<sup>21</sup> This is an internal dimension not measurable by objective tests but reflected in the discourse of individuals undergoing psychotherapy and experienced in their relationship with their psychotherapist. It may take widely varying forms and cause major emotional distress. People may be so overwhelmed by their internal world that they are no longer able to derive the full benefit from their rehabilitation program; as a result, they are less likely to adapt to their new neurological condition.

How should this psychological dimension be addressed when it disrupts rehabilitation? Should we simply ignore it and say it will resolve without our assistance, or should we try to control the impacts with medication or cognitive-behavioural strategies? The last few years have seen more extensive clinical literature on psychoanalytic psychotherapy (PP) being used to help individuals with a TBI (or acquired neurological lesions) who present with complex psychological problems.<sup>8,9,10,11,12,13,14,18,21,26,27</sup> This clinical trend focuses on PP as a specific therapeutic framework enabling clinicians to study this subjective dimension and intervene with respect to the elements underlying the suffering of patients.

The common, somewhat stereotyped image of PP may suggest that it is unsuited to the TBI clientele. Is it a relevant approach for helping individuals who have sustained a TBI and whose sequelae are caused directly by brain damage and not

their “subconscious”? And if a particular behaviour seems to stem from a psychological dynamic, do individuals who have sustained a TBI have the necessary cognitive baggage and introspective capacity to undergo this type of treatment? Given their problems with judgment, discernment and memory, will PP confuse rather than enlighten them in their process of understanding themselves and moving forward psychologically? Fine distinctions clearly have to be made with respect to both PP and the TBI clientele. Just as there is more than one way of practicing PP, TBI has more than one type of presentation.

Using PP as part of the rehabilitation process following a TBI is still an innovative approach. This article takes readers beyond the relatively stereotyped image of PP and provides the rehabilitation community with more information. The main objective is to show, using a clinical case as an example, how this therapeutic approach, used in conjunction with the neuropsychological intervention, can help us understand and deal with the complex psychological reactions that occur in some individuals who have sustained a TBI.

### Definition of psychoanalytic psychotherapy

Clearly PP is inspired by psychoanalysis. It draws from the same huge pool of *psychoanalytical theories* covering different aspects of mental processes and personality such as the structure and content of the mental system, psychopathology, personality development, analytical framework, etc. These theories have been evolving over more than a century, starting with the birth of psychoanalysis around 1895 with Freud and Breuer’s “Studies on Hysteria,” which contained the first systematic conceptualizations of the unconscious, through to the more contemporary object-relations theories that emerged in the 1960s and 70s after the ego psychology of the 1940s and 50s. Today we are seeing increasing empirical research and points of contact with other disciplines, including cognitive psychology and neuropsychology; as a result, it is now possible to test and enrich various psychoanalytical concepts.<sup>6,15,20,32,22,23,24,25,28</sup>

Although fuelled by empirical research, these theories are chiefly based on clinical observations obtained within a very specific therapeutic framework. This is the analytical method, which provides unique insights into the dynamic aspects of the personality. Through *interactive work* known as a “working alliance”, which involves psychotherapists as much as patients, it is possible to access certain representations (thoughts, images, memories, feelings, etc.) from which individuals have been protecting themselves more or less consciously. The method has also evolved from hypnosis to free association; people are encouraged to verbalize their feelings, sensations and fantasies, without excluding anything, even if they regard the content as unpleasant, ridiculous or of no interest. Today, we talk of the analytical framework, a space allowing the development of a therapeutic relationship of varying intensity, whose components and impacts are widely studied in psy-

choanalytical literature. Obvious examples are transference and counter-transference, which remain major therapeutic agents, as well as dream analysis and resistance analysis. Dreams are analyzed through the patients' free associations. Resistance analysis involves delving into the conscious or unconscious defenses that prevent patients from verbalizing during psychotherapy. Transference is the process whereby psychological issues are actualized in the relationship with the psychotherapist. Conversely, counter-transference refers to the possible psychological and emotional reactions of the psychotherapist to the subject during the sessions, which, as non-verbal messages, can help therapists understand their patients. The information is clinically significant because the issues affecting the subjects assume an authentic position within the relationship, even though patients are not usually aware of these issues and are therefore unable to verbalize them. Transference analysis is thus a unique opportunity to work on the concrete, actual aspects that reflect individual personality and play out in the relationship. With this method, subjects gradually become aware of the conscious or unconscious dynamics affecting the way they function, so that they may understand and free themselves from them. These are the *therapeutic effects* of the method.

PP is part of *traditional psychotherapy*. However, it differs from psychoanalysis mainly in that it is less intensive (1 to 2 meetings per week rather than 4 to 5) and more flexible and adaptable to different clientele. PP often has an analytical component and a psychological support component. The former stems from psychoanalysis (described above) and is aimed at gaining an in-depth understanding of the psychological issues of the subjects; the latter seeks to establish a framework that respects patients' individual limitations and capacities for adjusting to their problems. The therapeutic framework proposed by Lewis<sup>11</sup> for adapting PP to the TBI clientele is discussed after the description of a clinical case (see "Analytical psychotherapy of Ms. R."). PP also differs from *classic psychotherapy* used with TBI subjects in terms of its analytical component. The type of psychotherapy used with TBI subjects usually described in the literature focuses more on psychological support and instructional and rehabilitative interventions.<sup>1,3,4,16,19</sup> This form of psychotherapy can address the problems people have with coming to terms with their deficits and the resulting psychosocial difficulties. It also deals with self-esteem issues in a caring and understanding setting. It is of short duration and prescriptive in nature, focusing on reality and immediate concerns. PP is usually more intense, longer in duration and less prescriptive, focusing on the subjective dimension and its content, which may be more or less conscious. It tends to be used for more complex psychological reactions that require the treatment for a particular psychological problem. For readers who would like further information about PP and its various fields of clinical application, the work by clinicians at the Pavillon Albert-Prévost in Montreal<sup>5</sup> is highly recommended.

## Emotional reactions of the person who has sustained a TBI: The analytical perspective

After the devastation that can result from a TBI, some individuals regain their equilibrium with psychological support, while others are unable to do so, even years later. There are people who are unable to grieve for their losses and whose reactions are complex and intense. Some require more extensive treatment, and some do not progress as expected or even regress. How can we understand their emotional reactions? This is where psychoanalytical models come into play as a complement to neuropsychological models, helping clinicians better understand and address psychological reactions, while taking into account the influence of the premorbid personality on these reactions. Clinicians should consider not only the neuropsychological aspects explaining the cognitive impairments, but also the rest of the “psyche” in order to understand individuals’ behaviour and subjective experience. For example, the significance of the losses and a person’s capacity to mourn must be evaluated.

From the analytical perspective, the experience of people who have sustained a TBI is related to both the injury and the grieving process. From a psychological point of view, the *trauma* is an event that causes a sudden violent breach in psychological organization. The integrity of the subjects is threatened by this increase in excitation, which remains in their mental apparatus as energy they are unable to discharge or mentally work out, causing the symptoms.

Post-traumatic stress disorder is now recognized in persons who have sustained a TBI.<sup>7</sup> Psychoanalysis acknowledges the existence of a condition for which the determinant is the traumatic event itself. However, it takes into account not only the notion of trauma but also the predisposition of individual subjects to this trauma. The concept of trauma remains relative to the history and organization of the subject who has undergone the experience. Similarly, the loss (physical, cognitive or behavioural) carries a particular meaning, depending on the person who has sustained the TBI. If the loss (or event) resonates with a weak point in a patient’s personality, it may trigger or reactivate a conflict that is still unresolved.

*Grieving* as defined in psychoanalysis is the psychological process alleviating pain after the loss of a significant person or an important part of one’s own personality. This is by no means a passive process, as the individual “psyche” must work to detach itself from emotional links with the significant person or the lost portion of the self. These links may be complex and comprise both positive and negative emotions. The task may involve reliving memories of the person or the lost part, verbalizing hopes of regaining what is lost, and forging links with the new reality. In doing so, subjects mourn the loss and comfort themselves until the emotional links weaken or even disappear. This process is known as *working through*. Clearly, for various clinical reasons, this is sometimes very hard to accomplish.



The clinical case described below shows how PP can be useful in helping people who have sustained a TBI to resolve some of their conflicts so they can then complete the grieving process. In this case we see that the TBI stirred up unresolved conflicts relating to the person's sexuality; these had to be resolved in order for the person to accept her losses and regain her psychological equilibrium. Because the subject's personal history and the organization of her personality play an important role in this approach, the case is described in some detail.

### **Clinical case<sup>1</sup>**

Ms. R., an unemployed married woman aged 35, with 2 children aged 8 and 10, developed anxiety and major depression following a multitrauma with a mild to moderate TBI sustained in a road accident involving a head-on collision. The medical records indicated a score of 13/15 on the Glasgow Coma Scale, probable loss of consciousness, amnesia of the event, retrograde amnesia of several days, post-traumatic amnesia for approximately 10 days and a period of disorientation. The cerebral CT-scan was negative. The patient sustained many injuries (left temporal laceration, fractured collarbone, fractured left index finger, laceration of leg and left wrist), and multidisciplinary assessments identified an injury to the left eye, left homonymous hemianopsia, tinnitus, vestibular problems, hypersensitivity to noise and cognitive difficulties affecting attention, concentration, memory, and visuosperceptual and executive functions. Ms. R. was hospitalized for about 4 weeks at a rehabilitation centre in order to undergo intensive functional rehabilitation (IFR) and then continued outpatient treatment for a year. During this period, she underwent PP for her anxiodepressive reactions and was on 20 mg of Paxil. Shortly before her file was transferred to a different rehabilitation centre (the usual procedure when beginning the social reintegration phase of the rehabilitation), Ms. R's resistance to changing her psychologist culminated in a suicidal episode. In view of her fragile condition, it was decided that she should continue treatment with her original psychologist. The PP lasted nearly 5 years in all, with 1 meeting per week at the outset and subsequently 2 sessions per week. Ms. R. again presented with serious difficulties relating to issues associated with the end of treatment.

As a university graduate (in physical education and biology), Ms. R. had held various senior government positions in the civil service in her native country. She had not worked since arriving in Canada a few years before the accident. According to her husband, she was more fulfilled at home, in the family setting, bringing up the children. Ms. R. was described as strong and unshakeable when coping with problems. She liked helping disadvantaged people. She was also very involved with organizing social activities in her community. People valued her greatly for her

1. Identifying data has been changed to protect confidentiality.

dynamism, efficiency, sense of organization and positive outlook. She was a very lively, flamboyant person, and was also unfailingly polite, well-groomed and well-mannered.

One trait of *character* was strongly apparent and was clearly a defensive mechanism: she liked to do everything herself and be totally independent. For example, she refused to take advantage of her social status and insisted on doing all her own household chores (e.g. cleaning, gardening). If she had to go anywhere, she preferred to walk long distances rather than drive. She seemed to be fully in control of her life and her body. Ms. R. was also a beautiful, athletic woman who, to her surprise, had attracted the attention and admiration of men since puberty. She did not regard her body as anything special and paid no attention to it. She did not like parading at the big diplomatic receptions where she occupied a place of honour.

*In terms of personal history*, Ms. R. had a happy childhood; her mother was strong, “a leader who was very strict, but fair.” She remembered always obeying her mother even if she did not want to. For example, to do what her mother expected, she would come straight home from school without doing anything “fun”. She suffered from her lack of freedom. Ms. R. explained her mother’s very protective (or prohibitive) behaviour by the fact that in those days, everything a girl did was seen as a reflection of her maternal upbringing. She also recalled coming home and finding nobody there; her mother often had to take one of her brothers to hospital, as some of them were in delicate health. Coming home to a cold, empty house was frustrating. She would wait outside because she was afraid to be alone in the house. She was also afraid of small animals suddenly appearing. When she was older, her only fear was being alone in a room with a man and him closing the door. She hardly mentioned her father, who was described as hard-working, except to say that he worried during her many years as a student. She took a long time to get married, and he was afraid she would become a single mother and bring dishonour upon the family.

While she was at university, the *discovery of her sexuality* was very anxiogenic and occurred late, almost without her being aware of it. In her mind, there was no difference between men and women. She thought it was ridiculous and inappropriate if men made passes at her, and this attitude certainly “poured cold water” on these relationships. She reacted to such advances with surprise, experiencing them as a threat to her independence. She did not want to develop her own feelings in case they distracted her from her professional ambitions. In her native culture, and hence in her mind, men were out to seduce and manipulate her. Their strength made easy victims of girls who simply wanted pleasure and were unaware of the danger of becoming pregnant. This made her body and her sexuality both sacred and taboo at the same time, leading to a duality that took on contradictory forms. Though very attached to her clothes and her image, she refused the role of princess in the school play, in case the other girls were envious. For the same reason, she

slowed down during a running competition, so as not to win by too much. In the locker rooms, she was shocked when the other women undressed in front of her. Focusing on her body and physical appearance meant making herself vulnerable to temptation. She therefore felt it was her duty to be vigilant and keep her body firmly under control. When she came into contact with men, she appeared to be completely unaware that she projected both desire and the forbidden. Learning how to make people happy, she said, had turned out badly for her, because men thought she wanted more. For example, she had accepted a professor's invitation to accompany him on a long forest expedition, and he had tried to kiss her when they got back; she firmly and indignantly refused.

Her first kiss was from a man with whom she had been friends for some years. It happened in her room and she was deeply disturbed, experiencing pleasure and fear at the same time. She also felt she was losing control over her body, "a treasure that you don't give away." She therefore punished herself by staying in her room and studying for hours on end. She would later grow to love this man and become engaged to him. However, while her fiancé was abroad for a long period, she became involved with another man who eventually became her husband. Though she still had feelings for her fiancé, she felt that she could not afford to turn down this other proposal because her new friend had everything a woman could want: he was calm, kind, intelligent, and made her feel safe. She also remembered being very surprised when her future husband, whom at that time she regarded as just a friend, returned from a trip with a wedding ring for her. She had not realized how their relationship had evolved, even though she had asked him to bring her back a ring (to fit her ring finger) as a souvenir. A few weeks before their wedding, Ms. R. had her first sexual experience, after a *car accident*. She was so shaken up by this accident that she was able to rebel against her own taboos. After the love-making, she fainted. The next day, she felt shameful but liberated. After getting married, Ms. R. was able to experience sexual fulfilment as something that was "allowed" and pursue her career with the ultimate goal of being useful and helping others.

*Following her TBI*, Ms. R. presented with a number of physical and cognitive sequelae. Physically, her susceptibility to fatigue was particularly disabling. At home she was drowsy nearly all the time and spent most of the day in bed. At home or during treatment, her energy levels would suddenly plummet and she would fall into a quasi-sleep state for several minutes, while her vital signs remained normal. These sleep attacks came on gradually (not suddenly like narcolepsy) when she encountered a physical limitation or a topic that was too emotional. On waking, she often had severe nausea, vertigo, headaches and trouble walking, requiring physical assistance in order to move around though she had been walking normally when she arrived. When she awoke, she had usually forgotten what had upset her.

Among Ms. R's *psychological symptoms*, the main one was extreme distress at the thought that if she had died in the accident, her children would have been left

motherless. This idea caused her a great deal of revulsion and vulnerability. She felt guilty that she was in hospital, not at home taking care of the children. The psychological distress was sufficient to prevent her from participating fully in the rehabilitation treatments and for this reason, her discharge from hospital was recommended.

Ms. R. had also developed a *fear of car accidents*. She was afraid she would have another one or that her husband and children would also be in an accident. This idea caused her ongoing stress. She accompanied her husband when he travelled by car, and called him many times a day to check that he was safe and sound. She forbade her youngest child from playing in the alley and asked the oldest to call her as soon as he got to school. This “compulsion” to constantly check up on and monitor her children’s movements sometimes caused conflicts with them; she then felt miserable and thought she was a “bad mother”. Ms. R. had also developed *agoraphobia with panic disorder*. In open spaces, she felt as if she was suffocating and being sucked away; she was afraid of being left to such a fate and clung tightly to the person with her.

Along with her fears, Ms. R. suffered from *major depression*. She felt repulsion at her condition and felt unfairly deprived of her physical, intellectual and moral capacities. In her view, her deficits made her seem ridiculous to other people. She refused to see her friends and get involved (to the extent that she was able), in case people compared her with how she was before the accident: efficient, quick, active, lively, organized. She felt that having a diminished image was worse than having no image at all. Her pride had deserted her, and she had lost all interest in social activities. She was rebelling against her deficits. At home, she refused to adapt to her difficulties, saying that her condition was temporary. For example, she refused to use visual scanning strategies to compensate for her hemianopsia or adopt compensatory mechanisms to adapt to her mnemonic problems. She could never finish what she began, mainly because she refused to adapt to her limitations. As a result, she gave up on everything and felt she was a complete failure.

When Ms. R. talked about the loss of her functions, she said she felt she had been “*stripped*” of her physical and psychological health; she had the sense that she had left “most of herself” at the trauma centre and longed to “get back all the bits she had scattered behind her.” Defensively, Ms. R. kept up a continual struggle to control her emotions. She was very afraid of “being overcome by her emotions,” of losing control and “going crazy.” She felt she alone was to blame and was therefore not entitled to complain. Remaining silent enabled her to forget and distance herself from what was causing her anxiety. Nevertheless, she continued to be extremely vulnerable and feel as though she had no control over her life.

### Psychoanalytic psychotherapy of Ms. R.

In line with the organization of her personality, Ms. R.'s psychological reactions were complex and prevented her from deriving full benefit from her rehabilitation program. This is typical of individuals with both a neurological problem and a personality disorder, who cannot be effectively treated using solely a cognitive or neuropsychological rehabilitation approach.<sup>13</sup> Unfortunately, due to their neurological impairments, these patients do not often receive traditional psychological treatment. The intensive psychotherapy framework therefore must be adapted to accommodate these individuals. In a series of articles,<sup>10,11,14</sup> Lewis shows how PP can be adapted to the specific needs of individuals who have sustained a TBI and suggests a framework for developing this practice. To increase the chances that PP will help the person, 4 factors must be assessed and taken into account: the brain damage and the *cognitive sequelae* that may affect the psychotherapy; *psychological factors* (e.g. personality traits, general functions of mental processes) existing independently of the brain injury; the *significance and psychological impact* of the impairments on the individual, and the individual's social setting. Considered together, all these factors make it possible to predict how the person will react to psychotherapy, what conditions will be conducive to the therapeutic alliance, how the person will be able to talk about himself or herself and how the psychotherapy can be adapted to the individual's particular needs. In general, PP is a careful and flexible blend of support and cognitive remediation techniques on the one hand, with introspection and interpretation techniques on the other, adaptable to the person's needs at a particular time. Readers are referred to Lewis<sup>10</sup> for an illustration of technical variations within a PP intervention for persons who have sustained a TBI. The case of Ms. R. will now be reviewed according to the first 3 factors mentioned above.

To alleviate the impact of the *cognitive deficits* on the therapeutic process, the therapist and the therapeutic environment must first deal with the functions lost as a result of the brain injury.<sup>11</sup> The neuropsychological assessment identifying these dysfunctions is of key importance in ensuring the success of the psychotherapy. Among Ms. R.'s cognitive problems, her mnemonic problems were the ones that most affected the psychotherapy: her recall of content from one session to another was poor and dependent on cueing. She was also unable to take notes during or after the meetings because of her severe visuoperceptual problems. The compensatory strategies suitable for her residual capacities included recording a brief summary of each meeting (on a portable tape recorder) with the help of her psychotherapist. She could then begin each session by listening to the recording and decide whether to pursue the theme discussed at their previous meeting or start on a new theme. Note that despite her problems with explicit recall, Ms. R. did make significant progress (possibly on the implicit and emotional levels), and major changes steadily began taking shape on the psychodynamic level.

In adapting the psychotherapy to the person's cognitive limitations, it is important to differentiate between the impairments and the dynamic components; in other words, a distinction must be made between symptoms directly associated with the brain injury and symptoms stemming from a defensive process triggered by an emerging psychological conflict that was hitherto contained.<sup>10</sup> For example, Ms. R. would often faint during the sessions after talking about her sexuality; when she awoke, she did not remember anything. Her fainting, problems walking upon waking, dizziness, nausea, and headaches were all symptoms of her paroxysmal attacks (sleep attacks) and neurological-type conversion (somatoform) disorders (inability to walk and visceral manifestations) of hysteria.<sup>2</sup> This clinical impression was confirmed by a neurological and neuroendocrine examination. There was also the possibility that the impairments and dynamic components were interacting and maybe reinforcing each other; the impairments appeared to be "serving" the defence (or the drive, as applicable). For example, in Ms. R's case, fatigability, tinnitus and residual vestibular problems from the TBI may have been interacting with the hysterical symptomatology. Similarly, visuoperceptual problems, hypersensitivity to noise and the general need to reduce sources of stimulation were perhaps interacting with her agoraphobia. The relationship between psychological and neurological disorders is complex, and causality and determination may run both ways.<sup>10</sup>

The first step in assessing the *psychological factors* existing independently of the brain injury is an evaluation of the premorbid personality. According to Lewis and Rosenberg,<sup>13</sup> it is important to consider the level of organization of the person's premorbid personality, including perception of self and others, coherence of identity, impulse-defense configuration, and the capacity to modulate and experience emotions and conflicts.<sup>7</sup> The level of psychological development achieved prior to the TBI, particularly the degree of articulation of what are referred to as the functions of the ego, has a major influence on the person's self-perception; this in turn will modulate the capacity to adapt to the neurological condition. Ms. R's personal history allows us to identify major issues surrounding her sexuality, as well as the nature of her conflict in the hysterical sphere. First, the *deceptive side of her character* concealed a world of desires that she alone was not aware of. Her most threatening desires were kept firmly out of her consciousness by repression, which explains her "carefree attitude" towards her problematic sexuality. She was protected from superegoistic guilt. In her conscious mind, she had nothing to reproach herself for, apart from her desire to make people happy, which was erroneously interpreted by men. She was always the one most surprised when the truth was revealed. What was not seen, what appeared as the opposite through reaction formation, were her desires to attract and impress (exhibitionist). Instead, these desires were manifested in her determination to remain independent, to do things alone, in her own way (obsessional traits), away from the envious glances of women and the admiration of men. She avoided the role of princess on stage and the

“spotlights and glory” that her athletic feats could bring. Once she was married, a compromise at last seemed to take shape: devoting herself to the community, she had outstanding organizational and management skills and eventually earned the admiration of others.

Another element in her hysterical conflict was foreshadowed by her *erotized but not sexualized relations with men*. An old friend became “prince charming” after the disturbing effect of a single kiss. The desires then became unavoidable, the carefree attitude disappeared, and the conflict with the very punitive superego came to light. According to her fantasies, she was then under the threat of being a victim of, and dependent on, the man who had seduced her. Repression was no longer enough; projection took over, attributing her forbidden sexual desires to men and avoiding men as a phobic object. Her choice of objects also seemed to be governed by the phobic threat, and she married a less eroticized figure, but one who made her feel much more secure.

A final important aspect of her conflict was centred on her *body*. Sexual desires seem to have found an outlet through overinvestment in her body, which, at the same time, she was careful to discount. Her body was nothing special, and men were stupid to look at her. An attractive body could attract men, and she was therefore compelled to exert total control over her body, since below the surface of the proper and chaste woman may lurk carnality and immorality. Her additional efforts to preserve her independence (even physical independence, by refusing to drive anywhere) can be understood as an attempt to retain control over her body and, ultimately, her sexual desires. Considering the type of passive-dependent transference (discussed below) that Ms. R. established during psychotherapy, and the presence of multiple somatoform disorders in her symptomatology, Ms. R. presented a profile of moderate hysteria on a psychopathological structural continuum.<sup>2</sup>

A final element of her history was *the car accident* that enabled her to rebel against her taboos and enjoy sexual fulfilment. This event, associated with both pleasure and guilt, resonated with various circumstances following the TBI. This point will be revisited in the discussion of the psychological impact of the deficits or events.

*Following her TBI*, deprived of her defensive processes, Ms. R. plunged back into anxiety, guilt and depression. Losing her independence was a cruel blow. No longer able to play her active role as a woman regarded by everyone as strong and efficient, she was deprived of a major narcissistic supply. She lost her image and her pride; she was afraid people would compare her with what she had been and find her new self to be inferior. She did what she could to deny reality to temper her feelings of revulsion, but it was constantly catching up with her. All she could do was stay in bed, away from critical eyes. Her subjective experience comprised not only revulsion but also guilt. Therefore, losing her independence and her social roles also signified losing control of her body. She felt very guilty about losing her

abilities, and would not give herself permission to talk about it; she felt she alone was to blame for her problems. Her body no longer obeyed her, and she had become dependent in many ways. She now had to repress all her emotions as best she could, despite being deprived of her usual faculties, or she might go crazy. The increasing anxiety was therefore at the root of the phobic symptoms and paroxysmal attacks, serving as a compromise between desire and the forbidden. To understand these hysterical symptoms, we need to uncover their underlying psychological significance. Since her stay at the trauma centre, she felt that she no longer had ownership of herself. This feeling of having *surrendered ownership* was the key element in the psychological significance of her accident.

The *significance* (or mental impact) of the deficits and the events that preceded or followed the accident is usually revealed gradually through the psychotherapeutic process. Lewis and Rosenberg<sup>13</sup> recall the importance of encouraging reflection on negative emotions even in the person who has sustained a TBI. According to them, distraction techniques designed to distract the subject when upset in order to preclude a catastrophic reaction are not always productive or appropriate for all emotions; on the contrary, they may result in anxiety that is floating, generalized, and poorly understood because of unresolved emotional loads (e.g. rage, anger, shame, etc.). The role of PP is more to help subjects develop a capacity to think about their emotions (which are sometimes distressing), find out what they mean and, ultimately, use them in an adaptive manner. Ms. R. was not generally aware of her feelings during the sessions. The task of the psychotherapy was therefore to make her aware of her rigid, massive defences against her emotions and to link them to the anxiety of losing control. Ms. R. then gradually learned to express her emotions without being afraid of them. Dream analysis was also very useful, showing the contrasts, for example, between the contents of her daytime thoughts and of her oneiric thoughts. Ms. R. also had frequent nightmares involving battles, where she was forced to find solutions to situations she did not control. Here is one dream illustrating this conflict:

“I’m in a big room: something terrible is going on next door. I have to do something, but there is a big dog at the door standing in my way. As I approach, the dog grabs my leg. The pain is awful and I wonder how to make it let go of me. I want to bite it but I’m afraid something will happen to my eyes. So I find a place to bite it; I bite the dog’s leg and hold it between my teeth.”

The dream enabled Ms. R. to access her aggressiveness and become conscious of it. From the associations made with her dream, it was possible to discover a regression to the oral-sadistic stage. In the dream, we see the struggle she is engaged in to regain her independence, which is under savage attack and in great pain: the dog biting her leg and causing her great pain. Walking enables a child to have its first experiences of separation from its mother. When she was small, Ms. R. felt fragile when she came home and found her mother was not there. In the daytime,



Ms. R. seemed to be afraid of losing someone close in a car accident and of being left alone in wide open spaces. The separation anxiety seemed to be confirmed on another level by the suicidal episode that Ms. R. had experienced before her file was transferred to another rehabilitation centre and by the difficulties she had accepting the end of the treatment. Hidden behind Ms. R.'s strong independence, there was always abandonment anxiety.

According to Lewis and Rosenberg,<sup>13</sup> two repetitive and common themes emerge from the psychotherapy of persons who have sustained a TBI: anxiety and control of the affect on the one hand, and self-esteem and identity problems on the other. People who have sustained a TBI experience heightened anxiety and more psychological distress after their accident because of their diminished capacity to call upon their premorbid defensive processes and adaptation strategies. In the case of Ms. R., the loss of the physical capacities she needed to assert her independence (reaction formation) appeared to be associated with heightened anxiety about controlling her emotions (and more deeply, her sexual urges, as explained below). Reactivation of an earlier unresolved psychological conflict may also have increased the level of psychological distress. This gives us a better understanding of the accident's psychological impact on Ms. R. and brings us closer to its traumatic core. After a year of psychotherapy, Ms. R. was able to talk with difficulty about one of the major triggers of her *psychological trauma*. While she was hospitalized at the trauma centre (Ms. R. was told of these events after her period of disorientation), she was necessarily dependent on her environment, and her body was in the hands of others. She no longer "owned" her head or her body. The feeling was intolerable: she felt "that her innermost intimacy had been violated." In addition, she resented the people who took care of her and was immensely ashamed of losing control of her body. For a year, she did not want to see anyone. She felt she wanted to go far away and disappear. Relating these events during the therapy session, she spoke so emotionally that she seemed to be reliving the experience. Elements of theatrical dramatization were apparent. Immediately afterwards, she felt she had said too much, betrayed herself, had once again lost control (mainly of what she was saying) and was losing her train of thought.

There was a dynamic link between these events surrounding the physical care following the TBI and other events in Ms. R.'s past life. First, the car accident she was in before her marriage resonated with the physical care in terms of breaking down her sexual taboos. But in the first case (first stage of trauma), this breaking down was experienced as positive because it occurred within a relationship of trust, whereas in the second (second stage of trauma), the abolishing of taboos was experienced as a "rape", although the actions were in fact purely for her benefit. The intense guilt associated with the pleasure experienced after the accident prior to her marriage had not been dispelled. This memory trace was reshaped by the physical care administered "forcibly", which therefore took on an intolerable emotional load similar to that of a sexual assault. If the guilt she felt during the

physical care was so strong, it was because Ms. R. found the experience pleasurable, and this pleasure was traumatizing. Other past events may also have played a role in the genesis of this trauma, for example, the very unpleasant experience reported by Ms. R. of having to care for a gravely ill friend when he was naked.

*During her psychotherapy*, Ms. R. was encouraged not to betray herself, but to listen to her “true self”. She was led to establish various links, among others, between this recent traumatic experience and other events in her past during which she had also felt she lost control over her body and between current and past paroxysmal symptoms (e.g. sleep attacks after talking about her sexuality during psychotherapy and fainting after her first sexual experience). As the mental elaboration progressed, Ms. R. succeeded in talking about the physical care she had received at the trauma centre more calmly and realistically, and was able to see it as caring and beneficial rather than viewing it as an assault. Instead of blocking out these memories, she became interested in this period of her rehabilitation and started asking questions.

Subsequently, Ms. R. was able to open up to other issues that were key in her psychological adjustment to her new condition, namely, grieving for some of her intellectual qualities and her hysterical conflict, *which were closely linked*. The perceived change in her intellectual capacities deprived her of her active roles and left her facing sexual desires that made her feel very guilty. Ms. R. developed an eroticized transference to her therapist, whom she perceived as an idealized male figure able to cross the boundaries of her intimacy with respect, as well as the bearer of her cherished secrets. At the same time, however, the therapist was also perceived as a victim offended by her feelings, who would soon run away. It is easy to see the links between the transference roles assigned to the therapist and Ms. R.’s subconscious issues, of which she had never been aware. Through the *repeated interpretation of the transference* (e.g. working through), Ms. R. gradually progressed, in a continuous cycle of expressing desires, feeling guilty, using defensive processes typical of the hysterical character (reaction formation, repression, projection, sado-masochistic fantasies, acting out) and loosening her prohibitions as well as having feelings of acceptance and self-respect. The interpretation work (analytical component) was often complemented with educational interventions (support component) focusing on the resumption of certain prior roles in a modified manner. The goal was to stimulate Ms. R.’s interest in, and boost her confidence about, interacting more with her children in a context of play and discussion (as opposed to intellectual involvement in their education), getting out of the house, seeing friends and enjoying herself, and to help her feel that she was still useful and qualified to work as a volunteer with disadvantaged people.

*After this work*, Ms. R. felt transformed. She was able to talk about her feelings more freely than ever before. She felt lighter and liberated from her feelings of shame and most of the taboos. For example, she said she was an incurable romantic, but had always been afraid of her desires and had never allowed herself freedom.

Now she wanted to “explode” by fulfilling some of her desires and “come out of the darkness and see the sunlight.” Her fears about accidents and being judged by society had also been sufficiently allayed to enable her to undertake a few volunteer activities and participate in a trip. All in all, Ms. R. gradually opened up to certain adjustments as regards her new condition (the beginning of the end of her rebellion). She was also able to envisage the end of the therapy in an acceptable way. Though this was still very difficult, she said her survival no longer depended on it.

TBI results in multiples losses, and one of the hardest for the victim to cope with is the *profound loss of the sense of self, of one’s own identity*.<sup>13</sup> Psychotherapy is designed to help people grieve for a part of their pre-accident identity. It also seeks to construct a new sense of self that takes into account current limitations as well as the continuity between the former self and the current, post-TBI self.<sup>26</sup> These similarities may be explicit or implicit. For example, during psychotherapy, Ms. R. developed a better understanding of the need for control that she had before the accident and that so disturbed her after it; she showed she was able to question the strictness of her taboos and make them more flexible so that she could be more spontaneous and more indulgent towards the body that did not always obey her, especially since her TBI. She gave new meaning to her life by feeling that she was still useful, asking less of herself, and resuming a more active role in day-to-day events.

### **Limitations of PP for individuals who have sustained a TBI**

PP may only be used for certain people who have sustained a TBI, depending on the severity of the brain damage and the nature of the cognitive impairments. People with sensorimotor disorders, mnemonic problems, visuo-perceptual difficulties, mild language problems or abstraction difficulties are more likely to benefit from this approach than people with severe frontal syndrome, apathy, perseveration, impulsiveness or anosognosia.<sup>13</sup> These characteristics are common to a large percentage of TBI patients. Nevertheless, because TBI is not monolithic, these various cognitive problems may be present to varying degrees. Motivation, previous relational experiences, the ability to work towards goals, and ego strengths are all factors to be considered when deciding whether PP is indicated and determining the patient’s prognosis.

### **Conclusion**

The experience of persons who have sustained a TBI includes objective dimensions such as neuropsychological damage and a subjective dimension in which complex psychological reactions may come into play. In Ms. R.’s case, the loss of her physical capacities had cruelly robbed her of her defensive strategies against the threat of her sexuality. The physical care she received at the centre had triggered a psycho-

logical trauma by brutally transgressing her taboos about her control over her body, which was so important to her. Her subjective experience had resulted in major vulnerability in all aspects of her life: she no longer had control over anything and was paralyzed with anxiety and guilt. Her grieving for her physical and cognitive losses had ground to a halt.

Psychological reactions such as these may sometimes prevent people from fully benefiting from a rehabilitation program. PP attempts to better understand these issues and proposes an approach that combines psychological exploration with support. Complementing neuropsychology, it offers a way of intervening with certain individuals who present with complex psychological problems following a TBI, so that they can be helped to adapt to their neurological condition. The clinical case described clearly illustrates this demanding but productive approach.

## Acknowledgments

The author wishes to thank Dr. Marc-André Bouchard and the members of the CRIR publications committee for their enlightening comments during the preparation of this article.

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# Traumatic brain injury and psychoactive substance abuse

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**SUMMARY** – The article presents a review of the literature on the impact of psychoactive substance abuse (PSA) associated with traumatic brain injury (TBI). This dual problem, often encountered in the clinical setting by professionals working with people who have sustained a TBI and their families, requires a different approach for a clientele with specific needs. The literature shows that the intervention should deal with the PSA and the TBI in an integrated manner, simultaneously and not sequentially, as was formerly the case. Accordingly, professionals at hospitals or rehabilitation centres for TBI patients must be aware of the consequences of the synergy that results when PSA is combined with a TBI and be able to intervene appropriately. Professionals should have the relevant knowledge, and some should also act as resources with respect to this dual problem. They will then be in a position to train and support their colleagues while maintaining regular contact with clinicians at addiction centres, thereby ensuring their expertise is up-to-date. The simultaneous, integrated approach is designed to accurately document the consumption habits of individuals who have sustained a TBI and intervene to encourage social participation. The intervention also seeks to equip people and their families with ways to deal with the situation and generate appropriate solutions to this dual problem.

**KEYWORDS** – psychoactive substance abuse, traumatic brain injury, drug, alcohol, drug addiction, double problematic

## Introduction

The problem of psychoactive substance abuse (PSA) in individuals who have sustained a traumatic brain injury (TBI) has long been a concern of clinicians. Their limited knowledge of PSA, together with the dual diagnosis (PSA/TBI), often gives them a sense of powerlessness or even failure. The feeling of failure is intensified if the person has sustained a TBI following intoxication with alcohol, drugs or various substances and starts using them again during or after rehabilitation.

This article reviews the literature on the impacts of TBI when it occurs with PSA. What are the consequences of this dual problem for individuals, families and professionals?

As this review of the literature on the dual problem demonstrates, the topic is poorly documented in Quebec and Canada, despite its significant role in fatal accidents and severe injuries. Most of the documentation is from the United States and deals more with TBI in conjunction with alcohol than with other psychoactive substances. Authors tackling the dual diagnosis fail to specify the substance used, as well as the frequency and length of use. They also barely distinguish between substance use, abuse and addiction. These aspects are addressed in the scientific literature on addiction. The review of scientific literature covered the following databases: PsycInfo, Medline, Current Contents, Cinahl and Toxibase, Toxico Québec, the Société de l'assurance automobile du Québec (SAAQ) website, and the Canadian Health Network website. The keywords used were: *substance abuse and brain injury and family, substance abuse treatment and family, substance abuse and family, brain injury and family, toxicomanie et traumatisme crânien et famille, toxicomanie et famille.*

The article deals first with the definition and consequences of a TBI and PSA before describing American and Quebec intervention models. It goes on to focus on families of people who have sustained a TBI and find themselves at grips with PSA. The authors conclude by identifying the challenges for professionals in physical rehabilitation in their work with individuals presenting this dual diagnosis.

## Alarming statistics

There are few recent Canadian and Quebec figures on the prevalence and incidence of TBI, but it is thought that an average of 5,000 people in Quebec and 40,000 people in Canada<sup>30</sup> sustain this type of injury annually. In the United States, 2 million people sustain a TBI every year. And each year in Quebec, road accidents claim 2,000 victims, of whom 450 are 30 or younger and sustain permanent spinal cord injuries or traumatic brain injuries. Alcohol is a significant factor in 30% of fatal road accidents in Quebec<sup>31</sup> and in 40 to 50% in the United States.

Although Quebecers are becoming more aware of the devastating effects of drunk driving, the phenomenon accounts for more than \$100 million of taxpayers' money being paid out in compensation for road accident victims. Statistics



show that people aged 35 to 44 have the highest blood alcohol level when driving (40% of drivers killed in 2003 had blood alcohol concentrations of 150 mg per 100 ml, though the legal limit is 80 mg per 100 ml). A driver aged 20 with a blood alcohol concentration of 100 mg per 100 ml is 5 times more likely to have an accident than a driver of the same age who is sober. Under similar conditions, the risk is 40 times higher in a driver aged 16 to 19.<sup>31</sup>

Scant data is available in Quebec, Canada and the United States about the effects of other psychoactive substances on road accidents. A study in Quebec from 1999 to 2001 focusing on some other substances revealed that cannabis, cocaine and benzodiazepines were also found in some drivers.<sup>15</sup> Using more than one substance is systematically linked with a higher risk of road accidents, though alcohol remains the drug causing the most problems.

A large percentage of the TBI clientele admitted by Quebec hospitals and rehabilitation centres use psychoactive substances. For example, at the Institut de réadaptation de Montréal, the charts of 51.4% of TBI patients referred by trauma centres from 1999 to 2000 contained information about substance abuse (e.g. ROH, chronic alcoholism, multiple addiction, etc.). For 2000 to 2001, the percentage was 48%.<sup>19</sup>

Kreutzer *et al.*<sup>21</sup> estimate that 2/3 of chronic drinkers who sustain a TBI will resume problem drinking 1 to 2 years after the TBI. The combination of the TBI-related deficits and PSA has a synergic effect, predisposing people to more extensive cognitive and behavioural deficits, weaker social skills and poor social integration skills compared to a person with a TBI alone.

## TBI

A TBI affects the whole person. The impairment may be physical but it presents a major social challenge for individuals, families and professionals. Twice to three times as many men than women sustain a TBI, and their injuries are usually more severe. Causes include road accidents (45%), occupational accidents (10%), sports, recreational or household accidents (10%), and assault (5%).<sup>30</sup> Various deficits result, including cognitive disorders attributed to, among others, problems with memory, concentration, judgment and reasoning. Deficits associated with changes in behaviour are generally observed, including irritability, impatience, aggressiveness, mood swings, and apathy.<sup>25</sup> The recovery prognosis for people who have sustained a TBI depends on a number of elements, including the severity of the brain injury, individual characteristics, and the support available in their environment from family, friends, professionals, service agencies or associations. Alcohol and drugs appear to be unfavourable factors for the cognitive recovery and social integration of people who have sustained a TBI.<sup>4,3,21,30</sup>

The ultimate goal of rehabilitation is optimum participation in society; intervention models and approaches should promote the resumption of healthy life-

styles in the long term. Holistic or global approaches are recommended by, among others, Condeluci *et al.*<sup>10</sup> Based on the concept of empowerment, they encourage people to regain control of their lives and boost their confidence. According to Condeluci, interdependence allows interpersonal relationships to develop, helping people to resume the roles intrinsic to their well-being.

### Psychoactive substances

Health and Welfare Canada<sup>29</sup> classifies psychoactive substances according to their effect on the central nervous system. Depressants, which include alcohol, slow down the body's mechanisms. They have a sedative effect that reduces attention, concentration, and judgment and may affect memory. Stimulants increase or speed up the body's mechanisms; they keep a person awake and may heighten anxiety, irritability, and confusion. The last category is hallucinogens, which alter perceptions, emotions, and all physiological processes.

User behaviour is described in various terms such as “harmful use, abuse, dependency, addiction”.<sup>26,2</sup> The term “substance abuse”, used mainly by American authors writing about TBI and PSA, should be understood to mean *inappropriate use of a substance, resulting in altered functioning or clinical distress.*<sup>2</sup> Kreutzer,<sup>20</sup> an acknowledged expert on this dual problem, points out that this state has major social, family and professional repercussions. Dependence is described as “*a psychopathological behaviour with biological, psychological and social characteristics.*”<sup>226</sup>

These characteristics (e.g. low self-esteem, feeling of self-inefficacy, low stress threshold) are often observed in psychoactive substance abusers. They use mood-altering drugs to deaden their pain and anxiety and avoid facing reality. The more they rely on this solution, the less they are able to envisage healthier ways of dealing with their problems.<sup>27</sup> Though peer influence may be a contributing factor in PSA, a more fertile terrain is provided by a family setting that offers little support or cohesion between family members.<sup>9</sup> In a study of a TBI clientele, Corrigan<sup>12</sup> highlights pre-existing conditions that may contribute to PSA (43% dropped out of school, 30% were physically abused as children, 22% attempted suicide at least once, 21% had developmental difficulties, 18% endured sexual abuse as children and 16% were HIV-positive or had AIDS).

### Intervention approaches

In Quebec, there are various approaches to substance use, two of them very well known. They each have different views of substance abuse. Alcoholics Anonymous (AA) and Narcotics Anonymous (NA) are based on a traditional approach promoting total abstinence from psychoactive substances. Quebec's Comité permanent de la lutte contre la toxicomanie (CPLT), on the other hand, uses the harm reduction approach, which focuses on reducing the harmful consequences of using drugs rather than on eliminating their use altogether.

The AA worldwide fellowship was founded in 1935 and has 2 million members. “*The only requirement for membership is a desire to stop drinking.*” The organization uses 12 steps to recovery to lead members to “admit they are powerless over alcohol, come to believe that a power greater than themselves can restore them to sanity, pursue an alcohol-free lifestyle, and help other alcoholics.” This movement has spawned other movements based on the 12-step philosophy, among them NA, which targets people who want to stop using drugs entirely. AA, like NA, is concerned about people under 20 and their families and offers special services for them.

For Brisson,<sup>7</sup> harm reduction is not a new approach but a blend of concepts and experiences accumulated over the years in the field of drug addiction. The harm reduction movement came about as a result of the health promotion trend in the 1970s, in reaction to the illness model and biomedical model. Unlike the AA movement “*in which individuals recognize their powerlessness over alcohol,*” harm reduction encourages people to play an active role in combatting substance abuse. The term *harm reduction* was originally coined by the English-speaking creators of this approach. Brisson<sup>7</sup> regards the Quebec term *réduction des méfaits* (*harm reduction*) as a better translation than the European French term *réduction des risques* (*risk reduction*). *Réduction des méfaits* emphasizes the consequences of use, while incorporating the dual aspects of risk and harm. This broadens its scope to include primary prevention (risk management) and tertiary prevention (individuals themselves tackle the problem, and abstinence is not a requirement). The approach is based on two main principles: *pragmatism*, recognizing the universality of drug use and its negative consequences and targeting behaviour modification; and *humanism*, reaching out to users in their own setting, making the services they need available to them and promoting respect for their rights and their abilities to make their own decisions. Harm reduction recognizes consumption of psychoactive substances as a public health menace. It does not condone using or treat users’ behaviour as commonplace.

Tolerating drugs *is not the same as encouraging drug use.*<sup>6</sup> Tolerance depends on the context and the clientele; notable examples are minors, pregnant women and people with brain injuries. In other words, harm reduction does not exclude abstinence, but promotes choice and empowerment of the person by means of information, among other tools.

In 1996, the CPLT made recommendations to the Minister of Health and Social Services regarding drug addiction, with a view to setting up harm reduction programs across Quebec.<sup>6</sup> Like certain programs for the TBI clientele, these programs are designed to promote intervention with respect to PSA, using the steps set out by Prochaska and Diclemente<sup>28</sup> in their vision of “harm”.<sup>28</sup> These were developed in order to modify health-related dependency behaviours in general. The six steps take into account individual patients’ reactions and the desired intervention to set them on track for behaviour modification (see Table).

TABLE 1

<b>Precontemplation</b>	The person does not recognize the problem and is under social pressure to quit or modify PSA-related behaviours. Build a relationship of trust; mirror the person's pain.
<b>Contemplation</b>	The person is ambivalent towards the professional, thinking about the drawbacks and advantages of PSA.
<b>Preparation</b>	The person wants to change. Help the person by translating the desire for change into concrete, attainable goals.
<b>Action</b>	The person establishes concrete, realistic means. Provide support, work with the person on improving social skills; educate the person.
<b>Maintenance</b>	The person is modifying his or her lifestyle. Work on consolidating gains and the person's new image.
<b>Integration</b>	The person recognizes his or her ability to cope alone. Make support relationship more distant.

### Family, TBI and PSA

The news that a loved one has sustained a TBI is a major shock for the whole family. This new reality disrupts their normal functioning. The enormous stress on the family may well affect its ability to assess the situation and cope.<sup>14</sup> All families going through this ordeal are affected in some way. Often, a well-balanced, cohesive family is more likely to be disrupted immediately after the TBI. Kosciulek<sup>13</sup> believes the shock triggers temporary detachment in certain family members whose roles are usually well defined. But because these families are cohesive, they have a better chance of adjusting to the post-TBI situation in the longer term than a family that is not close and supportive.

Once they have been reassured that the injured person's life is not in jeopardy, the family's first reaction is to feel grateful. The next stage is dominated by the expectation that the person will make a full recovery in the first year. Confusion and anxiety ensue when the person's progress slows down. Dreams are shattered, and beliefs and values cruelly tested. Behavioural deficits and personality changes in the person who has sustained a TBI are the main obstacles to his or her social participation<sup>5,23,22,16,24</sup> and the cause of the greatest difficulties for the family.

When a family is faced with the combination of TBI and PSA, two reactions are observed. If the family is accustomed to alcohol or drug abuse, it may talk about PSA as something normal. Substance abuse is more likely to develop in families lacking in ties, closeness or communication, in which support and encouragement are not forthcoming. Professionals will sense that the family is not really interested in being part of the rehabilitation process. The second type of reaction, encountered more often in the clinical setting, is that of the family disapproving of one of its members engaging in substance abuse and being prepared to give the person one more chance to conquer it. Such a family is suffering, particularly if their loved one has sustained a TBI as a result of psychoactive substance abuse.

The dream of a full recovery, often cherished by the family of a person who has sustained a TBI and does not have the additional problem of PSA, may become a nightmare for a family whose loved one has substance abuse problems. Often these families have endured the horror and anxiety of their loved one's PSA and may believe that recovery from the TBI will be possible only if the person abstains completely. On the other hand, the family may prefer the person not to regain full autonomy but to remain safe, even if this involves residential care with on-site staff. Sometimes these families are less than wholehearted about collaborating in the rehabilitation process: they are not sure whether to celebrate the person's progress or worry about the slightest relapse. Families dealing with this dual diagnosis in a loved one will usually prefer an AA-type approach based on abstinence, rather than letting the person decide to cut down without abstaining completely. Although the professionals recommend abstinence for brain-injured individuals, it is essential that the professionals, the person and the family all work together to ensure that everyone shares the same vision of PSA and promotes the same objectives.

When a person with a TBI who has a history of PSA abstains from substance use while hospitalized, an opportunity arises for exploring PSA treatment.<sup>21</sup> The intervention models in the literature that focus on the dual diagnosis recommend a simultaneous and integrated approach, as opposed to a sequential approach; this means delivering TBI and PSA services at the same time, not in succession.

### **Intervention models targeting the dual problem**

Practices in Quebec have been influenced by two American intervention models: the *model of Kreutzer et al.*<sup>21</sup> and *Corrigan's model at the Ohio Valley Center*.<sup>11</sup> These models, developed at institutions serving a TBI clientele, recommend systematic training in dealing with the dual problem for professionals working with the TBI clientele. Kreutzer feels the best solution is to have an addiction expert on the care team. Corrigan believes it is preferable to identify resource people among the professionals and provide them with more comprehensive training on the dual problem. Like the harm reduction approach, both these American models recommend giving people the tools with which to modify their own PSA behaviours. The intervention in these models involves PSA screening, an education program for users and the setting up of support groups. The education program in the Corrigan model is based on Prochaska and Diclemente's steps.<sup>28</sup>

The family is immediately involved, to ensure they are informed and supported. They also follow education programs about the consequences of PSA and TBI. Instruction is provided in dealing with the dual problem, based on the different steps of change in the user, as proposed by Prochaska and Diclemente.

In Quebec, various programs have been developed, mirroring the fact that drug addiction is associated with a variety of health problems (e.g. mental health, youth

protection issues, TBI). Examples include the program devised by the mental health department at Hôpital Louis-H-Lafontaine and the one set up by the youth protection branch. Both are associated with the Centre en toxicomanie Dollard-Cormier, in the Cormier/Lafontaine and Jessie programs.

In the field of TBI rehabilitation, two intervention models addressing PSA are recognized for using a simultaneous, integrated approach. One of these intervention models, developed in a suburban Montreal rehabilitation hospital, collaborates with French- and English-language specialized addiction centres. Their intervention protocol is influenced by mental health intervention models and the model proposed by Kreutzer.<sup>21</sup> It is based on prior reflection on clinicians' values as regards drug addiction, a common definition of PSA, and their physical rehabilitation mission. The team members opted to have professionals from addiction rehabilitation centres on the physical deficit care team. These professionals intervene with people who have sustained a TBI and help to achieve the rehabilitation goals by integrating PSA-related objectives. The model hinges on information and teaching sessions for the individuals and families, encouraging patients to make their own decisions.<sup>18</sup>

Another intervention model, developed as part of a master's in social work,<sup>17</sup> proposes a partnership between a Montreal rehabilitation hospital and a drug addiction centre. It is influenced by the model described above and Corrigan's model. A professional from the addiction centre is asked to join the care team at the physical rehabilitation centre, to take part in the intervention with respect to the dual problem. The idea is to train clinicians from the rehabilitation hospital to become resource persons for drug addiction. In this model, the addiction professional meets with the people concerned individually, advises and trains the professionals, and acts as joint moderator at information and awareness groups. The joint moderators provide information about the dual problem to various partners in the physical rehabilitation network.<sup>17</sup>

## Rehabilitation challenges

Professionals working with a TBI clientele often feel poorly equipped to deal with an issue like PSA. Their personal views, as well as their professional values, are stringently put to the test.

Support from the environment, including the family, is a major factor in the recovery prognosis of people who have sustained a TBI. But the families are not always able to provide the same comfort when PSA is a factor. Professionals have to deal with families that are not cohesive and provide little mutual encouragement. Some families would prefer that a loved one with a PSA problem who has sustained a TBI make a less than complete recovery, so that he or she can no longer use drugs. Professionals must assess these situations and intervene, while still respecting the decision of the individuals and their families and adhering to the rehabilitation

mission and code of professional conduct. Because they lack expertise in PSA and the dual problem, this poses a huge challenge for professionals.

There is an urgent need for discussion and training focused on the dual problem, so that physicians and professionals intervene with the same goals in mind. Additional interventions also need to be contemplated for the TBI clientele with a history of PSA; people in this group are often reluctant to remain at an institution or follow a rehabilitation program. Sometimes it is not easy to distinguish which difficulties are caused by the TBI and which by PSA. When the symptoms of the two conditions are combined, symptoms actually multiply due to the resulting synergy. Drug addiction problems sometimes hinder progress in rehabilitation, and care teams are then faced with the dilemma of deciding when to discharge the person.

Convergent approaches from the drug addiction and rehabilitation fields are useful for addressing the dual problem. The harm reduction approach recognizes individuals' capacity to make choices and seeks to equip them to modify certain behaviours identified as problematic. Corrigan<sup>11</sup> feels professionals should not merely help people with a dual problem, but also equip them with tools so they can contribute to the process of change.

Policies respecting PSA at institutions that admit a TBI clientele must be clear, and professionals, clients, and families must be fully aware of them. Acknowledging that an individual is able to make choices in no way absolves personnel of their duties or responsibilities.

The major challenge for professionals is to understand the effects of the dual problem and how it affects social participation. How can we equip people who have sustained a TBI and developed a temporary or more permanent sense of inefficacy and low self-esteem, predisposing them to PSA? Undoubtedly, the answer to this question can be found through the creation of partnerships with the drug addiction field and the appropriate training. Drug addiction is a complex issue, addressed not with a single approach but with a range of approaches reflecting the person's needs. Certain individuals are at greater risk; for them, different approaches or ways that complement harm reduction should be envisaged.<sup>6</sup> One solution is to train professionals on TBI rehabilitation programs to act as drug addiction resources. Access to the expertise of addiction professionals should still be available, however, for when more intractable situations arise.

## Conclusion

It is hoped that this review of the literature on TBI co-occurring with PSA will trigger discussion about how to intervene with respect to this dual diagnosis. As the figures show, drugs and particularly alcohol have an impact on road accidents and account for 45% of TBI cases in Quebec. PSA is a major risk factor and jeopardizes the cognitive recovery and social participation of the person who has

sustained a TBI. Services for the clientele with this dual diagnosis should include accurate screening for substance abuse and monitoring of both the individual and the family. Clinical experience in rehabilitation of TBI clients with a history of PSA shows they are not receptive to hospitalization or conventional in-patient treatment. They soon ask to go home and disappear from the radar screen. As the harm reduction approach suggests, these individuals must be reached in their own setting and offered follow-up for their dual problem that responds to their needs and reality.

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# Benign paroxysmal positional vertigo and traumatic brain injury: Specific evaluation and treatment

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**SUMMARY** – Of all the possible causes of vertigo or dizziness in individuals who have sustained traumatic brain injury (TBI), benign paroxysmal positional vertigo (BPPV) is particularly common and relatively difficult to diagnose. There are a number of reasons why diagnosis is tricky: post-injury amnesia, confusion, agitation, fractures, pain, intra-cranial hypertension, and other associated vestibular pathologies. Diagnosis involves executing various provocative manoeuvres that must be adapted to the patient's medical condition. Treatment is based on a sound grasp of the technical principles behind the functioning of the three-dimensional anatomy of the peripheral vestibular system. It also must be adapted to medical conditions such as anxiety, confusion and pain. If these conditions are fulfilled, the success rate is fairly high. However, given the likelihood of relapse, the clinician should not be content with immediate results only. In order for individuals to remain symptom-free in the long term, they should be instructed in self-treatment, and care should be taken to make certain that they have mastered the technique sufficiently well to ensure it remains effective over time.

**KEYWORDS** – benign paroxysmal positional vertigo, traumatic brain injury

## Introduction

There are multiple causes for vertigo or dizziness in patients who have sustained a traumatic brain injury (TBI). Benign paroxysmal positional vertigo (BPPV) is one of the most frequent sources of vertigo after a TBI. The incidence of post-injury BPPV as opposed to so-called idiopathic BPPV<sup>33</sup> is around 10%. As long ago as 1964, Barber<sup>3</sup> found that when an accident resulted in TBI, the incidence of post-injury BPPV rose to 25%. This was confirmed in a recent study,<sup>30</sup> which found that post-injury BPPV ranked second as a cause of vertigo or dizziness in the mild TBI (MTBI) category, affecting up to 28% of the persons assessed. Precise incidence for the moderate and severe categories is unknown, but in view of the severity of the impact involved, it is probably as high, if not higher.

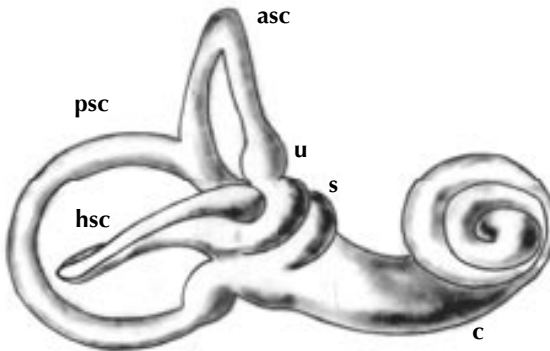
In an unpublished study<sup>32</sup> conducted at the Institut de réadaptation de Montréal, a fall was the cause of the accident in 60% of the 46 TBI subjects diagnosed with BPPV. According to Barber,<sup>3</sup> when the blow to the skull is sufficient to cause a temporal fracture, the incidence of BPPV is twice as high. Post-injury BPPV thus

appears to occur more often when the TBI is caused by a mechanism involving acceleration followed by sudden deceleration of the head, particularly where there are skull fractures.

The most common<sup>8</sup> physiopathological explanation of BPPV is based on a relatively simple hypothesis. The otoliths<sup>8</sup> (chambers in the labyrinth) are fragile, vulnerable accelerometers (see Figures 1 and 2). During acceleration-deceleration of the head, they undergo sufficient mechanical stress to damage their contents. As a result of the impact, the utricular otoconia (calcium carbonate crystals) may be dislodged from their matrix. Floating freely in the endolymph (the liquid in the otoliths and semicircular canals), they may migrate to other regions and clump together in one or more of the semicircular canals adjacent to the utricle. This produces a canalolithiasis (i.e. lithiasis in the canal) that interferes with normal functioning of the system (see Figure 2).

Vertigo is provoked by changes in the head position when the canal containing the lithiasis becomes parallel to gravity. With the combined acceleration force of the body and gravity, the lithiasis may overcome the inertia of the endolymph and amplify the response of the sensory receptors usually activated by these movements. The lithiasis provokes major nystagmus (involuntary eye movement), resulting in a moving visual scene instead of the static one expected. This translates into a sensation described as vertigo.<sup>8</sup>

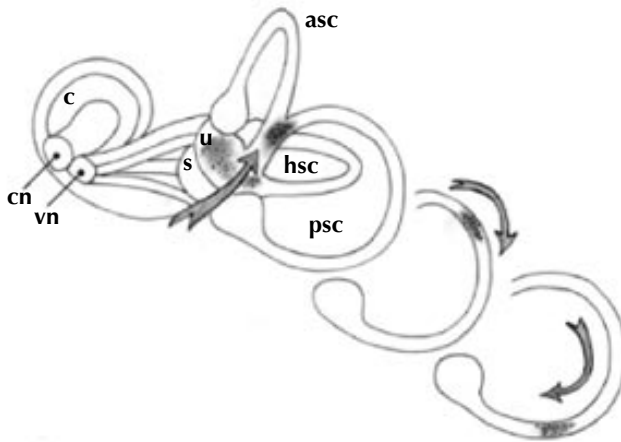
FIGURE 1  
**Anatomy of the labyrinth**



Lateral view of right vestibulocochlear system. Note the semicircular canals (anterior, posterior and horizontal) attached to the utricle. Canals have only one unobstructed end attached to the utricle.

- psc = posterior semicircular canal
- asc = anterior semicircular canal
- hsc = horizontal semicircular canal
- u = utricle
- s = sacculle
- c = cochlea

FIGURE 2  
**Physiopathological mechanism giving rise  
 to benign paroxysmal positional vertigo**



The injury dislodges the otoconia from their matrix in the utricle. Floating in the endolymph, the lithiasis, composed of otoconia and other debris, is then able to migrate into one of the 3 canals and enter through an unobstructed opening. Here we see the progressive migration of the lithiasis to a right posterior canal. Displacement of this lithiasis during head movements may be the reason for post-injury BPPV.

psc = posterior semicircular canal

asc = anterior semicircular canal

hsc = horizontal semicircular canal

u = utricle

s = saccule

c = cochlea

vn = vestibular nerve

cn = cochlear nerve

People with BPPV experience brief but intense vertigo when changing position, accompanied by nausea and occasionally vomiting. Anxiety in these patients is often observed with movement, due to the unpredictable nature of the attacks. Symptoms and problematic positions vary depending on the location of the lithiasis in the canal<sup>8,26</sup> (see Table 1). Spontaneous remission is possible. However, the recurrence rate is very high,<sup>1,4,50</sup> up to 50% of cases. BPPV should therefore be regarded as a chronic pathology, with alternating periods of remission and exacerbation. The duration of symptomatic periods depends chiefly on the success of the treatment and is therefore founded on the subject's self-treatment skills.

TABLE 1

**Characteristics of vertigo based on positions and diagnostic criteria of benign paroxysmal positional vertigo by canal**

Characteristics	Posterior Canal	Horizontal Canal
Provocative manoeuvre	Dix-Hallpike or side lying	Roll test
Vertigo		
• Turning over in bed	++ on one side	+++ on both sides
• Standing up or lying down	+++ especially AM	+/-
• Leaning forward	++	+/-
• Looking up	++	+/-
• Looking to right or left	-	++
Nystagmus	rotatory on affected side, vertical upward movement reverses upon return	horizontal geotropic or apogeotropic, on both sides
• Duration	< 30 sec	> 30 sec
• Latency of onset	3-15 sec	absent or < 3 sec
• Fatiguability	Yes	no
Neurovegetative SY	+/-	+++

Note: Lithiasis of the anterior canal has virtually the same symptoms as those of the posterior canal. They should appear with the same provocative manoeuvres. However, nystagmus will be rotatory towards the affected side, but vertical and downwards.

## Diagnosis

### *Provocative manoeuvres*

BPPV is diagnosed by means of systematic execution of various provocative manoeuvres: Dix-Hallpike, side lying, and roll test.<sup>8,26</sup> The purpose of these manoeuvres is to cause maximum displacement of the lithiasis in the semicircular canals in order to reproduce the nystagmus causing the sensation of vertigo. Because each canal is neurologically linked with certain extra-ocular muscles,<sup>8,26</sup> the nystagmus provoked by these tests is a unique signature revealing the exact location of the lithiasis. When the nystagmus is pronounced, it is not easily inhibited by the visual system and is therefore easily visible to an attentive examiner. However, where the nystagmus is less intense, specialized equipment (Frenzel, video-oculography) is essential.

### *Diagnostic criteria*

The diagnostic criteria for BPPV are today fairly well established.<sup>8,18,17,26,22,46</sup> They are based on reproducing, with manoeuvres, vertigo accompanied by nystagmus.

The characteristics of the nystagmus such as onset latency, direction, duration, speed and amplitude of movement, and attenuation of response to repetition of manoeuvres and reversal of direction (see Table 1) are used to confirm the diagnosis and document the location and type of lithiasis causing the BPPV.

#### *Locations of lithiasis*

The most common canalith location (60 to 90% of all lithiasis<sup>31,9</sup>) is the posterior canal. The percentage of lithiasis in the other canals is lower and varies with different studies. The patient may also have multiple affected unilateral or bilateral canals.<sup>36,33,3</sup>

#### *Diagnosis of post-injury BPPV following a TBI*

Diagnosing post-injury BPPV in a person who has sustained a TBI is slightly more complex than for BPPV from other causes. There are various reasons for this: modification of body movements, poor compliance, associated medical conditions, other vestibular causes and somatoform presentations.

#### *Behaviour modifications*

Given the unpleasant nature of the vertigo and the related neurovegetative symptoms, patients soon learn to avoid attacks by moving more slowly or avoiding certain positions. After a TBI, this behaviour often goes unnoticed, because pain and psychomotor slowness are common, particularly in the first few weeks.

#### *Degree of cooperation*

The cognitive and behavioural sequelae complicate the identification of post-injury BPPV. For example, confusion, agitation, or hostility may make it difficult or impossible to conduct tests due to the poor cooperation of the patient. Moreover, during the period of post-injury amnesia, taking the history is unreliable. Sufferers rarely report their vertigo, even when asked about it. In these circumstances, if the clinician suspects the presence of BPPV based on the mechanism of injury (fall with sudden deceleration and fracture), *indirect* assessment is preferable. When the individual sits, lies down or turns over in bed, the eyes can be observed for nystagmus, as the location of the lithiasis depends on the provocative movement and characteristics of the nystagmus.

#### *Associated medical conditions*

TBI is often accompanied by related conditions (fractures, pain, intra-cranial hypertension, weakness, paresis, or abdominal trauma) that may complicate or prevent diagnostic manoeuvres. However, even when the provocative manoeuvres are no longer contra-indicated, we often must depart from conventional positions and modify the environment in order to provoke the symptoms and nystagmus.

For instance, when examining a patient with a cervical fracture treated with a rigid collar, the clinician should elevate one end of the examination table and turn the patient's torso to obtain the 25° extension and 45° rotation of the head required for the Dix-Hallpike Test.

### *Other related vestibular pathologies*

The presence of other vestibular pathologies (with nystagmus) complicates the diagnosis of BPPV. The characteristics of nystagmus associated with BPPV may easily be contaminated by other nystagmus, sequentially (one nystagmus after the other) or vectorially (the directions of the nystagmus adding up or subtracting from each other). For example, with a purely rotatory, horizontal or vertical nystagmus, central vestibular disorders, particularly post-injury vestibular migraines<sup>30</sup> and central paroxysmal vertigo, must be eliminated.<sup>8,10</sup> If there is vertigo with horizontal nystagmus, we must be sure to distinguish between unilateral peripheral vestibular hypofunction (fixed-direction nystagmus, whatever the provocative movement) and horizontal canalith BPPV (variable direction, depending on the canal affected).

Since it is not uncommon for vertigo to have several vestibular causes, the simplest procedure is to start by treating the most problematic pathology, which is very often post-injury BPPV. Once BPPV is resolved, it will be easier to diagnose residual vestibular pathologies and choose the appropriate treatments.

### *Somatoform presentations*

Finally, if the nystagmus is atypical, especially where there are balance problems that are easily modified by suggestion and distraction, we must also consider the possibility of somatoform presentation, a clinical profile that appears to be somatic, but is probably mainly psychological.

## **Treatments**

### *Introduction*

There are various reasons why treatment of BPPV in individuals who have sustained a TBI is unavoidable. First, it is well documented that people with BPPV also have balance problems<sup>5,6,15</sup> because the otolith is also affected. If the person who has sustained a TBI already has precarious balance, which is often the case in elderly people, the presence of BPPV increases the risk of falls. Treatment is also necessary to prevent injuries, accidents, or falls if the person's job involves performing tasks at heights or handling electrical tools, or if he or she engages in sports. In addition, it has been demonstrated that, because of the intensity of the vertigo and its aversive nature, the presence of BPPV had a significant impact on quality of life for the people affected.<sup>38,23</sup> Finally, according to a recent study, people who



have sustained a TBI experience more attacks of vertigo per day than people with idiopathic BPPV.<sup>12</sup>

### *Treatment approaches and efficacy*

Techniques for treating BPPV have greatly evolved since the first treatment was published in 1980 by Brandt and Daroff.<sup>7</sup> They are usually classified by their presumed actions on the lithiasis or the vestibular system. To treat BPPV, 4 techniques (with variations) are normally used: repositioning,<sup>20,34</sup> liberatory manoeuvre,<sup>52,14</sup> prolonged positioning<sup>54,13</sup> and, as a last resort, habituation<sup>7</sup> (see Table 2). With the exception of habituation, all these techniques can cause migration of the lithiasis along the reverse path towards the utricle. Because of the discomfort provoked by the neurovegetative symptoms, these treatment techniques are based on active cooperation by the patient.

Various meta-analyses or randomized studies of posterior canalolithiasis<sup>37,55,29</sup> have shown that these different techniques have equivalent efficacy and a high success rate, even with only a few sessions.<sup>25</sup> Success appears slightly lower for canalolithiasis of the horizontal canal, but this information comes from a few studies that were mostly retrospective and conducted with a small number of subjects.<sup>21,14,34,54,2,44,46</sup>

The treatment is generally safe and well tolerated. The only side effects are usually neurovegetative symptoms, chiefly nausea, often accompanied by a feeling of spatial disorientation that affects balance. These effects are temporary. If necessary, to attenuate the neurovegetative effects or anxiety<sup>53,47,56,24</sup> caused by the thought of reproducing the vertigo, Epley<sup>17</sup> recommends using anti-emetic or anxiolytic drugs prior to treatment.

TABLE 2

### **Advantages and disadvantages of treatment techniques for benign paroxysmal positional vertigo, by approach**

<b>Treatment Techniques</b>	<b>Advantages</b>	<b>Disadvantages</b>
Habituation	<ul style="list-style-type: none"> <li>• simple to execute</li> </ul>	<ul style="list-style-type: none"> <li>• requires perseverance</li> <li>• non-specific technique</li> </ul>
Liberatory	<ul style="list-style-type: none"> <li>• speed of execution dislodges adhering debris</li> <li>• useful for elderly people</li> <li>• easy to learn</li> </ul>	<ul style="list-style-type: none"> <li>• execution at high speed</li> <li>• requires good mobility</li> <li>• conversion possible</li> </ul>
Repositioning	<ul style="list-style-type: none"> <li>• easier monitoring of nystagmus and vertigo</li> <li>• execution better controlled if patient is anxious</li> </ul>	<ul style="list-style-type: none"> <li>• difficult to learn</li> <li>• requires cervical or thoracic extension</li> <li>• conversion possible</li> </ul>
Prolonged positioning	<ul style="list-style-type: none"> <li>• technically undemanding</li> <li>• easy to learn and memorize</li> </ul>	<ul style="list-style-type: none"> <li>• cannot be used for posterior lithiasis</li> <li>• prolonged period in same position</li> </ul>

The presence of multiple affected unilateral or bilateral canals makes treatment of BPPV particularly complex, increases the duration of treatment, and raises the risk of relapses. Treatment usually begins with locating the most symptomatic canal. At each new session, the nystagmus and vertigo must be reassessed so that the clinician may pinpoint the most problematic location.

Post-treatment complications are rare.<sup>27</sup> The most common is canalithic conversion. This occurs when the lithiasis fails to follow the expected path and switches canal. Identified promptly, this complication is easily rectified. The other complication, which is rarer but more disabling, is canalith jam.<sup>19,16</sup> This requires appropriate action as described by Epley.<sup>19</sup>

Balance problems<sup>56,15</sup> accompanying BPPV often disappear after the vertigo is treated.<sup>56,15</sup> It is therefore more effective to treat BPPV before balance problems. If these problems persist, postural control and balance rehabilitation will be required.

#### *Technical aspects to take into account during treatment*

According to Epley, vibrating the mastoid during repositioning treatment may facilitate migration of the canalolithiasis. A number of studies<sup>28,43,40</sup> have evaluated the usefulness of this oscillation and found it has no effect on treatment efficacy. However, one study<sup>35</sup> has assessed the usefulness of vibration when associated with low-speed repositioning, and found it has a major impact in these circumstances.

The most intractable canalolithiasis is the horizontal apogeotropic type (with nystagmus beating away from the ground). The whole problem is the location of this lithiasis, probably anterior, which must be made to migrate posteriorly towards the utricle. This is achieved by using conversion techniques,<sup>44,21,42,11,2</sup> converting the apogeotropic nystagmus to geotropic, which is indirect proof of displacement towards the utricle. Fortunately this canalolithiasis location is rarer than the geotropic type.

Most techniques for treating BPPV are accompanied by strict instructions to be followed by the patient during the 48 hours following the treatment. There appears to be a link between the sleeping position and the affected side.<sup>39</sup> Patients are usually told to avoid certain sleeping positions and specific head movements. According to the studies,<sup>41,45</sup> avoiding sleeping on the affected side, the restriction described by Sémont,<sup>52</sup> does not enhance treatment efficacy. However, there have been no studies evaluating the restriction suggested by Epley,<sup>17</sup> which actually stipulates sleeping on the affected side.

Because of the likelihood of recurrences, the main challenge in treating BPPV is to maintain resolution of vertigo in the long term. Two approaches may be used: the prophylactic approach, involving daily execution of the techniques, or the symptomatic approach, involving execution of the techniques only in the event of relapse. As yet, no studies have assessed the efficacy of the prophylactic approach

to measure its impact on the intensity of recurring vertigo and its incidence. All the treatment techniques used for BPPV may be executed in self-treatment, either daily or when symptoms occur. However, the repositioning and liberatory manoeuvres appear to be more effective than habituation.<sup>48,49</sup>

*Specifics when treating post-injury BPPV associated with TBI*

Diagnosing BPPV in individuals who have sustained a TBI requires plenty of imagination, and the same applies to treatment. The right techniques must be chosen or adapted, bearing in mind the patient's clinical condition and age. A number of adjustments to the therapeutic environment or positioning of the patient will be required, especially for patients with fractures, pain, weakness or anxiety. It is important to pick the right moment for the assessment and initial treatment, because subsequent cooperation is largely determined by how well the first session goes. A three-dimensional model containing lithiasis is very helpful for explaining the pathology, demonstrating the sequences of movement used during treatment, and reducing apprehension about the treatment (see Figure 3).

FIGURE 3

**Three-dimensional model used for explaining benign paroxysmal positional vertigo and its treatment**



The model consists of utricles and semicircular canals mounted on a styrofoam head. Lithiasis are presented in each canal. Moving the head enables us to view the various canalithic migrations and explain the pathology and treatment.

The presence of anxiety, either premorbid or secondary to the TBI, may complicate treatment of BPPV. The technique used by Li<sup>34</sup> for treating a posterior canalith is the only one not to provoke any symptoms, because repositioning is done slowly. Clinicians will find this approach useful, not only when dealing with anxious patients, but also those who do not fully grasp the pathology or individuals with major neurovegetative symptoms. The only drawback is the inability to

track migration of the canalolithiasis because at low speed, no nystagmus, and hence no symptoms, should be provoked. This technique should be executed with vibration of the mastoid<sup>34</sup> so as to overcome inertia of the endolymph during migration of the lithiasis. However, vibration should not be used in cases of temporal fracture, unless instructed otherwise by the physician. The other repositioning techniques may be used according to the same principles.

Because of the cognitive problems (mnestic particularly), trying to impose mobility restrictions post-treatment on anyone who has sustained moderate or severe TBI is often unrealistic. We can therefore ignore these restrictions, except when the post-injury BPPV is complicated by multiple locations and severe anxiety or cooperation problems. For patients such as these, we can, for example, modify the environment (pillows between mattress and base, bolster to prevent turning over) to ensure they sleep with the head elevated and on the affected side.<sup>17</sup>

In view of the likelihood of relapses, the prophylactic approach is recommended if the post-injury BPPV is associated with temporal fractures, multiple canalith locations, or anxiety. Because of memory and motor learning problems, numerous repetitions of the self-treatment technique will be required. Audiovisual materials, teamwork, education and support from the family are also good ways of ensuring that proper self-treatment techniques are maintained over time.

#### *Prognosis for resolution of post-injury BPPV in association with TBI*

Despite the lack of studies on the prospects for resolving BPPV following treatment in persons who have sustained a TBI, failures are rare. They can usually be attributed to lack of cooperation or the inability to collaborate, or else to major anatomopathological changes in the canals preventing migration of the lithiasis.<sup>51</sup> In the latter cases, surgery may be considered, but only if the residual capacities, especially postural and balance control, are sufficient not to be excessively affected by the side effects of surgery.

### **Conclusion**

Treatment of post-injury BPPV in persons who have sustained a TBI must be adapted to the different medical conditions premorbid or secondary to the injury, whether they are systemic, behavioural or cognitive. Appropriate treatment depends on a precise diagnosis, which is sometimes difficult to achieve, for reasons that include limited cooperation, multiple canalithic involvement and other vestibular deficits. Treatment often takes place after thorough psychological preparation of the patient and modification of the techniques or environment, always respecting the underlying principles. The challenge is to help patients remain symptom-free in the long term by involving them as much as possible and ensuring that they have mastered the technique sufficiently well for it to remain effective over time.

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## PART III

# Contemporary perspectives

### 1. The need for clinical practice guidelines in cognitive rehabilitation

*Claude Paquette*

### 2. Clinicians, managers, and researchers: Joining forces to measure quality in rehabilitation services

*Bonnie Swaine, Carolina Bottari, François Crépeau, Louise Demers,  
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# The need for clinical practice guidelines in cognitive rehabilitation

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**SUMMARY** – The pertinence of providing cognitive rehabilitation (CR) to individuals who have sustained a traumatic brain injury (TBI) is no longer disputed, but the various methods and procedures continue to be applied in an intuitive and arbitrary manner, for lack of evidence-based clinical practical guidelines. This article discusses the need for standards of practice in CR, and the importance of a partnership between clinicians and researchers for establishing them.

**KEYWORDS** – cognitive rehabilitation, traumatic brain injury

## Introduction

Traumatic brain injury (TBI) can affect an individual in many dimensions: physical, intellectual and cognitive, psychoemotional and social. The resulting disabilities, both short and long term, usually stem from cognitive and behavioural sequelae that compromise the person's autonomy and social participation.

Cognitive rehabilitation (CR) is offered in 95% of rehabilitation programs for TBI patients<sup>7</sup> and is defined as *a systematic, functionally oriented service of therapeutic cognitive activities that is based on an assessment and an understanding of the person's behavioural deficits*.<sup>1</sup> To help them resume their regular activities, individuals are taught strategies (e.g. using a diary) or sometimes shown how to modify their environment (e.g. install visual cues in the home) or work directly on deficits (e.g. scanning training for patients with visual field deficits). CR is designed to optimize residual capacity, maintain acquired skills, and promote adjustment, to make people as autonomous as possible. Because each individual has particular characteristics, there is no magic formula that can be universally applied. Interventions must match a person's needs and reflect individual idiosyncrasies.

In clinical practice, CR is offered through neuropsychology, speech therapy or occupational therapy. However, a survey of 122 American and Canadian institutions shows that of the three professions, neuropsychologists are the least involved

1. Commission for Accreditation of Rehabilitation Facilities.

in CR.<sup>15</sup> Neuropsychologists “often” or “always” offer CR in fewer than 60 of the 122 programs that responded to the survey, compared with speech therapists (122/122) and occupational therapists (approximately 100/122). These figures are surprising, considering the whole purpose of neuropsychology (understanding the link between the brain and cognition) and the long training undergone by neuropsychologists (particularly in the United States, where a postdoctorate is often the minimum requirement). In Quebec, one reason that neuropsychologists are under-represented in CR is that fewer of them work in the clinical setting. The ratio of patients to neuropsychologists means clinicians are only able to offer about 2 hours of therapy per week to each individual, compared with the 5 hours per week offered by occupational therapists. With less time available, neuropsychologists devote themselves chiefly to behavioural and emotional problems; as psychologists, they regard these aspects as their particular field. Moreover, some neuropsychologists show little interest in CR because its efficacy is not easily demonstrated.<sup>15</sup>

### Validity and efficacy of CR

Because CR is a relatively new discipline, the shortage of proven treatment methods obliges clinicians to proceed by trial and error when treating certain cognitive dysfunctions. Only very recently have clinicians been able to start following proven procedures supported by conclusive findings documented in the literature. Against a socioeconomic backdrop of health care funding constraints, rehabilitation programs have to prove themselves “economically” worthwhile. Rehabilitation therefore must be not only effective (i.e. produce the desired results), but also efficient (i.e. produce the best results with the shortest possible hospital stay, at the lowest cost). For clinicians, this involves adhering to professional ethics and using worthwhile treatment methods that meet recognized scientific criteria and do not risk harming the patient. The clinician must use contemporary best practice. To meet this criterion for excellence, the current trend in favour of evidence-based medicine<sup>12</sup> has multiplied the amount of research focusing on outcome in all areas of health care.

Meta-analyses dealing specifically with the efficacy of CR and published in the last few years<sup>5,6,9</sup> are steering us towards more rigorous practices. The work of Cicerone *et al.*<sup>6</sup> highlights the benefits of establishing guidelines for CR with adults who have sustained a TBI. Three types of recommendations were developed based on the relative strengths of the methodology and the number of studies demonstrating the efficacy of the intervention concerned. The first type, Practice Standards, comprises interventions with definite positive effects. It is therefore considered essential to use this evidence-based intervention when treating a particular problem. There are Practice Standards for treating hemineglect, speech and language problems, and mild memory deficits. The second level, Practice Guidelines,

indicates a modicum of certainty as to the treatment's efficacy. The treatment of attention or visual field difficulties, the use of problem-solving strategies, and the holistic approach to rehabilitation fall into this category. Finally, the third level, Practice Options, refers to interventions for which there is favourable evidence of treatment efficacy, but an insufficient number of statistically reliable studies to demonstrate it with certainty. This category includes memory aids and other compensatory tools, as well as computer-assisted teaching of strategies. The meta-analysis by Cicerone *et al.* also makes recommendations about approaches that should be avoided because they have proved ineffective (e.g. exercises on the computer without the therapist's guidance).

Focusing specifically on the treatment of attention difficulties, which account for most cognitive problems following a TBI, Park and Ingles<sup>9</sup> conducted a meta-analysis of 30 studies. Individuals receiving training to restore attention processes (e.g. the approaches of Ben-Yishay *et al.*<sup>2</sup> and Sohlberg *et al.*<sup>13</sup>) and control group subjects did not differ significantly: 52% of participants in a specific attention training program improved on measures of cognitive performance, as did 48% of control subjects who had received no training. According to Park and Ingles, this shows that attention training using specific stimuli of the "mental gymnastics" type does not restore attention processes. However, training in specific skills that require attention (driving, reading) resulted in a marked difference between the groups (69% improvement vs. 31%). The meta-analysis by Cicerone *et al.*<sup>6</sup> produced the same findings, i.e. that attention training should be accompanied by the learning of strategies. As Sohlberg and Mateer<sup>14</sup> point out, the most important indicator for evaluating the success of attention training is how well the individuals function in daily life, not how well they perform on psychometric tests.

### Need for clinical practice guidelines

To ensure that CR respects the highest quality standards (efficacy, validity, compliance with patient's needs), clinicians would benefit from clearer practice guidelines. The 1980s saw the publication of CR procedures manuals and practice guides. They included the extensive work of CR pioneers such as Ben-Yishay.<sup>1</sup> Institutions like the Rancho Los Amigos Hospital<sup>8</sup> and the Rehabilitation Institute of Chicago<sup>4</sup> also published CR manuals, which recommended certain interventions for clinicians and suggested what materials they should use based on the individual's cognitive deficits. However, the manuals were based solely on clinical experience; though unquestionably valuable, this alone does not meet the criteria of optimum efficiency and efficacy.

For example, variables such as frequency and duration of the interventions may have a decisive effect on the outcome of CR, but as yet, there is little precise information regarding the choice and pace of therapy. In a review of the literature on the effects of rehabilitation on TBI patients, Ricker<sup>11</sup> asked the pertinent question

as to whether more rehabilitation produces better results. One answer to this question is provided by Cicerone *et al.*<sup>7</sup> The authors compared 2 rehabilitation approaches used with subjects who had sustained a TBI. The first involved intensive CR, i.e. 5 hours a day for 16 weeks, individually and in groups, to treat cognitive deficits, make patients aware of them, and work on communication, interpersonal relations, etc. The control approach was a traditional neuro rehabilitation program (physiotherapy, occupational therapy, neuropsychology, speech and language therapy).<sup>2</sup> The results show that at the end of the study, individuals in both groups improved. However, those in the intensive CR program functioned better in daily activities and community integration and on cognitive efficiency tests than the subjects in the traditional program.

While the Cicerone study partly answers the question about necessary durations and frequencies producing better results, it does not specify what durations or frequencies are sufficient. At what point should the patient be discharged, and based on what indicators? Further questions remain to be addressed with evidence-based data. For instance, at what stage should CR interventions begin? Which deficit should be treated on a priority basis, given that TBI results in multiple cognitive deficits? What is the best frequency of intervention for optimum learning? Is treatment efficacy always the same regardless of educational level, age, extent of cognitive deficits, or pre-injury intellectual performance? Answering these questions would enable us to define the context leading to best practice. To achieve this, two-way exchanges between researchers and clinicians are essential.

### **Researcher-clinician partnership**

Research in the CR field needs more guidance from clinicians. Reciprocal collaboration would enable the clinician to steer the researcher towards various aspects including:

- 1) patients' needs within their own biopsychosocial context, given that interdisciplinary rehabilitation in Quebec is usually based on this philosophy;
- 2) ecological validity of intervention programs;
- 3) a realistic view of the applicability of intervention protocols, reflecting the inherent restrictions of the clinical setting (equipment available, duration of interventions, cost, etc.);
- 4) generalization potential of the methods proposed.

The above elements are rarely applied to research coming out of university laboratories, where the focus is often on fundamental aspects of cerebral or cognitive function (e.g. location of function in the brain, construction of theoretical

2. Cicerone's article does not specify how many hours of cognitive rehabilitation per week were administered in the traditional program, but it may be inferred that subjects received 5 to 8 hours of therapy per week, compared with 25 hours in the experimental program.

models of cognitive architecture) and rarely on how to treat cognitive dysfunctions.<sup>3,16</sup> This is confirmed by Powell, Hunt and Pepping,<sup>10</sup> who report that the cognitive sciences have so far been of little help to CR clinicians, in part because the two fields have different goals.

A lot remains to be done to ensure that CR is based on proven methods; to achieve this goal, clinicians need to work with researchers. Few clinicians have the knowledge to develop experimental protocols with flawless methodology, and few are sufficiently familiar with statistical analysis. Moreover, the day-to-day clinical setting requires therapists to perform a multitude of tasks on a fixed schedule that leaves no time for designing experimental protocols.

In CR, partnership between the clinical and research communities is still the exception; concerted efforts to forge such partnerships, supported by the organizations involved (institutions delivering rehabilitation, research centres and funding agencies), are needed.

## Conclusion

Evidence-based clinical practice is in itself an intervention model. Evidence-based practice guidelines are now available in clinical psychology; neuropsychologists interested in cognitive rehabilitation would be well advised to follow suit. The challenge of this discipline is no longer a matter of knowing whether it is possible to rehabilitate someone with cognitive deficits; the challenge now is to determine the best procedure to enable the individual to function optimally in everyday life. Clinicians working in cognitive rehabilitation may have to review, modify, or even forego certain practice habits reinforced by clinical intuition alone, as they strive to attain exemplary clinical practice in cognitive rehabilitation.

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# **Clinicians, managers, and researchers: Joining forces to measure the quality of rehabilitation services**

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**SUMMARY** – A multi-site multidisciplinary team of researchers, clinicians, and managers has been developing the French version of the PQRS-Montreal questionnaire (Perception of Quality of Rehabilitation Services — Montreal). The goal of PQRS-Montreal is to assess traumatic brain injury (TBI) clients' perception of the quality of rehabilitation services across the continuum of care. As of yet, there is no valid, reliable tool for measuring this perception among this clientele. According to Donabedian, assessing quality of medical care and services based on the opinions of people receiving them is a valid way to obtain information from which to deduce quality indicators. A review of other literature on the measurement of perception of quality of medical care (e.g. patient satisfaction) suggests that the PQRS-Montreal questionnaire will be the first tool to enable precise measurement of many aspects of care involved in an ideal rehabilitation process for TBI clients throughout the continuum of care. The PQRS-Montreal questionnaire has the potential to become an important tool for managers and clinicians in the evaluations currently used during the accreditation process for adult TBI rehabilitation programs.

**KEYWORDS** – perception, quality of services, rehabilitation, traumatic brain injury

## Introduction

The prototype of the Perception of Quality of Rehabilitation Services (PQRS-Montreal) questionnaire (administered during an interview by a specially trained person) was developed using standardized methodology<sup>10</sup> previously described in detail.<sup>11</sup> We consulted a variety of information sources in order to determine the questionnaire content (i.e. the dimensions of care deemed to be important to include in the tool): the scientific literature on measuring satisfaction, a report on service needs of Quebecers who have sustained a traumatic brain injury (TBI),<sup>6</sup> and the work of Dutil *et al.*<sup>4,5</sup> The criteria identified by Dutil's team<sup>5</sup> were a major guiding force. Next, the content (i.e. the choice of dimensions of care and their definitions) was validated with members of the team, using a technique for obtaining consensus, the Technique for Research of Information by Animation of a Group of Experts (TRIAGE).<sup>7</sup> Five dimensions of care were chosen: client-centred approach, ecological approach, continuity of care, team quality and accessibility. The TRIAGE technique was used to determine the standards (n=27) for all the dimensions of care (see Table 1, Appendix). Finally, items in the questionnaire were generated in brainstorming sessions. These items alluded to certain interventions felt to be important or certain actions on the part of health care professionals that should be part of the ideal rehabilitation process. The prototype of the PQRS-Montreal questionnaire contained 87 items, and clients were asked to indicate the extent to which they agreed or disagreed with each, on a scale ranging from 1 (Completely disagree) to 5 (Completely agree).

Once the prototype was developed, the validity of its content was confirmed with other health care professionals outside the team and working in the different TBI programs throughout the continuum of care. The goal was to ensure that the tool would be applicable right across the continuum, from early rehabilitation

through to social reintegration. The clarity of the prototype's content was evaluated with clients representative of the target population. This article presents the results of the consultation process that culminated in version 1.0 of the PQRS-Montreal questionnaire. A study assessing the questionnaire's validity and reliability involving over 600 TBI patients is currently underway.

## Methodology

A qualitative approach was undertaken, using focus groups to obtain the viewpoint of health care professionals and managers. Invitations to take part in the study were sent to all managers of Quebec's 28 TBI programs. Their expertise, or that of health care professionals working at their institution, was solicited to validate the content of the questionnaire. The items were assessed for clarity and pertinence with respect to the rehabilitation phase at which each person worked and the clientele involved. The exercise was also designed to reduce the number of items, thereby making the questionnaire easier to administer.

Seventeen health care professionals and managers (5 men, 12 women) from 10 centres in 3 different administrative regions of Quebec agreed to participate in the study. They worked in different disciplines (occupational therapy, neuropsychology, speech therapy, social work, nursing, and physiotherapy) at the time of the meetings and 10 of them held the position of clinical coordinator.

The team organized 2 focus groups (both led in the same way), to reflect the potentially differing perspectives of health care professionals and managers of the various stages of rehabilitation. One group comprised health care professionals and managers working in early rehabilitation (acute care centre); the other comprised people working in intensive functional rehabilitation (IFR) or social reintegration.

During the consultation with the expert groups, the team again used the TRIAGE technique to validate the tool's content. TRIAGE, described in detail by Gervais *et al.*,<sup>7</sup> is a structured and interactive technique used to obtain a consensus from experts on a specific theme. It is a rapid, effective technique for gathering important information required for reaching decisions. The TRIAGE process has 2 phases, a preparatory phase based on individual contributions, followed by a production phase based on the collective contribution.

In the preparatory phase, information provided in a participants' guide was sent to the health care professionals and managers. This contained a list of items in the prototype and a brief description of the study goal and the TRIAGE technique. Participants were asked to rate the relevance of the 87 items in the PQRS-Montreal questionnaire prototype on a scale of 1 to 5, ranging from "Not pertinent" to "Very pertinent". They also had to prepare for the meeting by considering 3 questions:

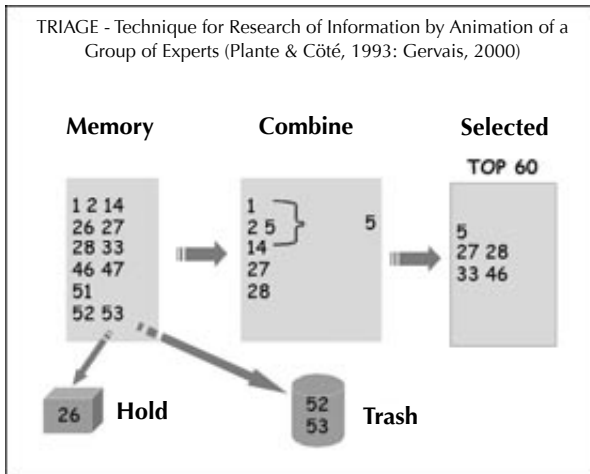
- *What impact would this type of questionnaire have on your program?*
- *What would be your reasons for using or not using the questionnaire?*
- *If your program wanted to use this questionnaire, which member of your team could administer it, and what would be the best time?*

Participants returned the information to the person compiling the study data in preparation for the production phase.

The production phase, which took place about a month later, involved a focus group with the same participants. The 4-hour discussion was led by one of the study coordinators assisted by an observer. Moderation adhered to the group dynamic principles described by Mucchielli<sup>8</sup> and Anzieu and Martin.<sup>1</sup> Participants were told that the purpose of the meeting was to select the 60 items deemed most pertinent to include in the questionnaire (i.e. the Top 60). Using the TRIAGE technique (see Figure 1), the discussions addressed various categories of items created in response to the individual answers (e.g. those deemed pertinent by 85% of participants, 70% of participants, etc.). The items were initially placed in the “Memory” column and each item was then discussed in turn. Items unanimously felt to be pertinent were hardly discussed at all and were immediately moved to the “Selected section”. Discussions followed about items that people felt were important to reject, along with the reasons for rejecting them. Certain items were combined into one (where applicable), then selected, rejected as “Trash” or put on “Hold” for future verification. Finally, the 2 groups were asked about their general opinion of the tool and their interest in using it.

FIGURE 1

**Example of using the TRIAGE method to select items (Gervais, 2000)**



Note: Headings and items were visible to all participants. The numbers indicate the different items.

The discussions also highlighted items that could be ambiguous for TBI patients. Clarity of these items was also validated in individual interviews with 3 clients with different clinical profiles, from 3 different centres. The 3 clients were men aged 36 to 75 years; 2 had sustained a severe TBI, and the third a moderate TBI. They were representative of the target population having fatigue, attention and memory problems. One of the clients also displayed impulsiveness, aggressiveness and perseverance.

The final stage in the validation process was to examine simultaneously (during another work session with the team members) the results of the consultations with focus group participants. Each item was analyzed using a triangulation process (see Figure 2). This involved compiling all the results obtained from the clinician/manager groups, clients and the research team, in order to answer the following questions: Was the item pertinent (did it allude to an intervention or action supported by the literature), and did it take into account the continuum of care? Was the item clearly formulated? A final decision was then made about whether or not to retain the item.

FIGURE 2

**Example of an item submitted to the triangulation process**

The team gave me ways (e.g. logbook, diary) of dealing with my cognitive problems.

	Phase I	Phases 2-3	Team	Clients
	X	X	X	X

Client comments: Do not understand the word *cognitive*

Final decision: Retained  Yes  No

Final version: The team provided you with useful ways of coping to help with your memory and concentration problems (e.g. forgetting an appointment, being easily distracted, being unable to focus, etc.).

**Results**

The 2 focus groups were used to identify the most pertinent items for the questionnaire. In all, 56 items from the prototype PQRS-Montreal questionnaire were retained by the group of early rehabilitation clinicians and managers, 62 by the group of clinicians and managers in IFR and social reintegration. For the sake of clarity, these results are presented in 3 categories: items that both groups felt were irrelevant, items that only one group felt were pertinent, and those that both felt were pertinent.

Sixteen items were unanimously rejected, mainly because they were too specific, redundant, or referred to events, attitudes or actions not considered necessary in

an ideal rehabilitation process. Examples of items rejected for being too specific were:

- *The centre where I was hospitalized had recreation or exercise rooms.*
- *The facility had enough parking spaces.*

The specificity of the different stages of rehabilitation and their respective mandates meant that some items were only rejected by the group of early rehabilitation clinicians and managers, while others were rejected only by the other group. Fifteen items were rejected solely by the group of early rehabilitation clinicians and managers. These items dealt mainly with organizing the return to school and work, resumption of leisure activities and in-home services and treatment. Examples of items rejected were:

- *At least one team member paid attention to the impact of your injury on your sexuality and helped you with this problem.*
- *The team helped you develop your work skills.*
- *The team helped you resume your leisure activities.*

Participants felt these items were not pertinent mainly because they mentioned aspects of care not contemplated at such an early stage of rehabilitation or alluded to an aspect of care felt to be outside their program's mandate or of low priority at that stage. The number of items rejected solely by the group of participants working in IFR and social reintegration was lower (n=4). One item was felt to be "too discipline-specific", and 2 were regarded as redundant. The fourth was seen as irrelevant because it referred to the team's openness about having family members present during treatment sessions and this aspect of care is implicit to an ideal rehabilitation process.

Both groups were unanimous about the pertinence of 15 items, which dealt mainly with information, respect of the individual, involvement of the family, communication, accessibility (financial and physical) and the availability of personnel. Below are 5 examples:

- *The team was competent.*
- *They explained clearly what services were available for you at the facility.*
- *When you were discharged and went home permanently or moved to your new environment, the team made sure your family and friends were ready for you.*
- *In (name of facility), you had to repeat your story several times (e.g. details of accident, marital situation).*
- *You had to repeat the same tests several times without being told why.*

A few items about the potential sequelae of a TBI, such as fatigue and memory problems, were "put on hold" for subsequent review by the research team:

- *The team helped you better cope with your sleeping problems.*
- *The team helped you better organize your activities despite your fatigue problems.*
- *The team helped you better carry out your activities despite your pain.*

Comments by participants about the questionnaire's usefulness and quality revealed that all except one person (in the IFR and social reintegration group) wanted to use the questionnaire in their program at their institution. Many participants described the questionnaire as accessible, pertinent and complete. The case manager, coordinator and social worker were recommended as being best placed to administer the questionnaire towards the end of the patient's stay. Clinicians and managers also noted that essential questions were missing (e.g. I felt listened to, supported, secure, respected, etc.). They suggested adding an open-ended question at the end and felt it was important to put questions specific to the family in a separate section. They also recommended using simpler language.

The point about simplifying the questionnaire's language came up again during individual interviews with clients. The clients sometimes found it difficult to understand the "professional" jargon. The items were therefore extensively reworked to include more familiar terms and to ensure that each contained only one idea. The interviews also highlighted various comprehension problems with respect to answer choices particularly when people are not yet at the stage of rehabilitation referred to in the item.

During the work sessions as part of the triangulation process, the team decided to retain items deemed pertinent (at the meetings) by at least one group, so as to reflect the specific aspects of the different stages of rehabilitation across the whole continuum of care. The research team engaged in detailed discussions about how to handle items deemed irrelevant by the majority of participants. Before removing any, the team made sure the item did not refer to a clinical intervention or action supported by the literature and felt to be important for the social participation of TBI clients. Finally, because the team felt it was important to develop a tool specific to TBI clients in view of the particular nature and complexity of their needs and the rehabilitation programs, it was decided to retain the items put on hold during the TRIAGE technique (items dealing with particular features of the sequelae in the target clientele were retained). As a result of the triangulation process, the team identified 61 items and produced the first version of the PQRS-Montreal questionnaire.

## Discussion

The objective of the focus groups was achieved by the 2 groups of clinicians and managers: they identified the most pertinent items and reduced the number of items in the questionnaire. The fact that many items were unanimously judged to

be pertinent demonstrated that a degree of consensus exists among TBI clinicians and program managers with respect to certain aspects of the ideal rehabilitation process, despite the different perspectives and mandates of the 3 stages of rehabilitation. The questionnaire will therefore feature a common block of items that can be evaluated across the continuum of rehabilitation care. However, some items are still more specific to a particular stage of rehabilitation and are therefore more important for one stage than another. Finally, including all these items will give clients the opportunity to express their opinion on all the items, regardless of the stage at which the questionnaire is administered.

Following this consultation with clinicians and managers outside the research team, the questionnaire was substantially modified (certain items were made more precise and examples were added, while some were removed) and version 1.0 of the PQRS-Montreal questionnaire was produced. The team also followed the recommendation about adding an open-ended question at the end. Version 1.0 now contains 2 open-ended questions, one asking what users most appreciated about their rehabilitation and the other asking what they liked least.

This was an ideal opportunity to benefit from the wealth of clinical experience and expertise of clinicians and managers. Bringing various groups together enabled everyone to take part in developing a tool reflecting all levels of care and the service needs of TBI clients. The clinicians' and managers' contribution to the focus groups was essential in validating the questionnaire's content and rendering it appropriate for a TBI clientele.

Consulting with people who had sustained a TBI was also extremely rewarding. These interviews highlighted the need to use the most appropriate language in the questionnaire, so that respondents fully comprehend the underlying meaning of the items. Upon completion of this work, we asked a speech therapist, experienced with this clientele, to check the level of language in the questionnaire. The interviews also confirmed the need to use an experienced interviewer who is familiar with the clientele, to ensure the data collected are of good quality. A user's guide was developed for people administering the questionnaire; it emphasizes the importance of using someone from outside the treatment team in order to ensure that the client is completely comfortable answering the questions.

## **Conclusion**

This article describes the steps taken in developing and validating the content of the PQRS-Montreal questionnaire measuring TBI clients' perception with respect to the quality of rehabilitation services. As a result of meetings with clinicians and managers from TBI rehabilitation programs and several clients, the items most pertinent for the questionnaire were identified, the number of items was reduced, and 2 open-ended questions were added. This study demonstrates that not only researchers but also managers and clinicians are keenly interested in evaluating



rehabilitation programs. The collaboration with the various partners described in this article is essential when developing this type of tool and illustrates the major contribution by key players in the concerted effort to improve TBI care and services. The members of the research team are greatly encouraged to pursue their work towards developing a valid, reliable version of the PQRS-Montreal questionnaire that will eventually be used by these programs. More recently, we have received requests for national and international collaboration (Toronto, United States, Italy) to validate translated versions of the tool, reflecting the growing interest in the PQRS-Montreal questionnaire.

### Acknowledgements

This project received funding from the Réseau provincial de recherche en adaptation-réadaptation (REPAR) and the Fondation de l'Institut de réadaptation de Montréal. We wish to thank the clinicians and managers in the various TBI programs and the 3 clients for their valuable collaboration. We also thank Andra Calota for her help with the focus groups and the compilation of data, and to Nancie Brunet for her assistance with the triangulation process. Finally, special thanks to Claire Trempe for her help in drafting this text.

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APPENDIX

TABLE 1

**Dimensions of care and corresponding standards retained**

Dimensions	Standards
<b>Ecological Approach</b>	Consideration of environmental facilitators and obstacles Evaluation/intervention pertaining to life habits and social roles Evaluation/intervention in real life surrounding Interfacing with real life surrounding Liaison with community organizations
<b>Client-centred Approach</b>	Individualized approach for client and family Client's empowerment with respect to decisions about rehabilitation objectives and means of achieving them Proposition of general and specific information to client and his or her family Holistic and global interventions focusing on client's needs Participation by client and family in elaborating an individualized intervention plan Respect of client's rights (i.e. dignity, intimacy and confidentiality)
<b>Quality of service providers</b>	Efficacy of service providers Administrative procedures Competence of service providers Decision-making process Mechanisms for communicating information among team members Team member interactions (closeness, cohesion and complementarity) Therapeutic attitude towards client Sufficient human resources Service provider stability over time
<b>Continuity of care</b>	Complementarity between programs and partners Pertinence of referrals Maintenance and pursuit of objectives among different facilities programs and phases of care Waiting time for services Follow-up Delays between planned service and service received Waiting times between programs at different facilities Preparation for transfers / weekend leave
<b>Accessibility</b>	Proximity of services Physical accessibility of premises Convenience of opening hours Safety of premises Ease of transportation (to and from facility) Promptness of start of treatment Ease of formalities / simplicity of administrator procedures Affordability Visibility Availability of service providers Availability of services in mother tongue Availability of services



SECTION TWO

**Mild traumatic brain injury**

PART I

**Current state of knowledge**

1. Identifying the sequelae of mild traumatic brain injury in children  
*Isabelle Gagnon, Robert Forget, Bonnie Swaine, Debbie Friedman*
2. Premorbidity and mild traumatic brain injury in adults  
*Pierre Nolin, Johanne Bernier, Jennifer Mawn,  
Nathalie Boutin, Myriam Lanctôt*



# Identifying the sequelae of mild traumatic brain injury in children

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**SUMMARY** – Despite the increasing attention focused on the phenomenon of mild traumatic brain injury (MTBI) in rehabilitation, the consequences of this type of injury are still a matter of controversy. The main objective of this study was to examine the balance skills and response times in a group of children who had sustained an MTBI during the 12 weeks following the injury, and to compare the results with those for uninjured children matched for age, sex and premorbid level of participation in physical activities. The study also had the secondary objective of determining whether, 12 weeks after the injury, the MTBI children maintained a level of physical activities, a perception of their athletic competence and a level of self-efficacy comparable to that of the pre-injury period and that of the control group children. Forty children who had sustained an MTBI and 40 uninjured children were recruited for this study. The MTBI children had a mean Glasgow Coma Scale score of 14.8 and were regarded as normal based on the usual neurological evaluation. Balance and response times were assessed 1, 4, and 12 weeks after the MTBI, and assessments of the level of participation in physical activities, perception of athletic competence and self-efficacy were conducted the day after the accident and repeated 12 weeks after the MTBI. The main results showed that MTBI children presented an initial performance that was lower than those of the control subjects with respect to balance skills and response time. Their scores improved during the 12-week period, but for some of the measures, remained low. Moreover, at 12 weeks post-injury, the MTBI children had returned to their pre-injury level of participation in physical

activities and maintained their perception of their athletic competence. However, they had lower self-efficacy when engaging in physical activities.

**KEYWORDS** – traumatic brain injury, children, adolescents, balance, response time, physical activity

### Introduction

Mild traumatic brain injury (MTBI) is generally thought to account for 75 to 80% of all traumatic brain injury (TBI) in children.<sup>22,26</sup> Despite its high incidence, MTBI has long been, and still is, viewed as the cause of few major deficits. While it may seem pointless to dwell on the sequelae of an injury regarded as minor, there were 2 main reasons behind this study. First, some children who have sustained an MTBI have anecdotally expressed dissatisfaction when they resume their usual physical activities. They were unhappy about not performing as well as before the accident or felt “something was not right”. In addition, scientific evidence reports motor or balance problems in adults<sup>15,14,16</sup> following an MTBI. In children, an exploratory study<sup>10</sup> demonstrated the presence of balance and visuomotor response time deficits in a single assessment during the immediate post-injury period (2 weeks after MTBI). A more specific study investigating the evolution of children’s performance in these domains and their resumption of physical activities was therefore of definite value.

The identification of sequelae following MTBI in children poses a number of the same difficulties as in the adult MTBI population. The debate surrounding the existence of sequelae is fuelled by methodological problems with scientific studies investigating MTBI, such as the heterogeneous nature of the population with respect to severity, the absence of reference groups, and the use of non-specific measures of deficits.<sup>5,4</sup> In addition, the conclusions drawn from studies in adults are frequently applied to the pediatric population indiscriminately, even though the specificity of children is crucial. For example, Kraus *et al.*<sup>21</sup> and Levin *et al.*<sup>23</sup> describe the etiological and pathophysiological differences between pediatric MTBI and that sustained by adults. In children, the injuries are often caused by falls during activities (at low speed), as opposed to motor vehicle accidents (at higher speed), which are the most common cause in older adolescents and adults. The incomplete development of children’s organic systems renders them potentially more vulnerable to the effects of MTBI in childhood and early adolescence. However, the fact that children mature at a widely varying pace in all domains makes it difficult to decide whether a slowing of functions or maturation should be attributed to natural variations or to the TBI.<sup>9,23,28</sup> Determining the presence or absence of deficits in children, particularly after an MTBI, clearly requires that precise criteria be determined to define the severity of the injury, the skills assessed, the follow-up period, and the careful selection of a comparison group.



The principal objective of this research was therefore to describe, during the first 12 weeks after MTBI, the balance abilities and visuomotor response times of a group of children, and to compare them with those of a reference group of uninjured children matched for age, sex and pre-injury level of physical activity. The secondary objective was to investigate the impact of an MTBI on their level of participation in physical activities like sports or games, their self-efficacy level related to physical activities, and their level of athletic competence 12 weeks after the injury.

## Methodology

A sample of 40 children who had sustained an MTBI and the same number of children without MTBI, aged 7 to 16, were recruited. Children could participate if they had a diagnosis of MTBI as defined by the American Congress of Rehabilitation Medicine,<sup>25</sup> functional knowledge of French or English, and the capacity to walk safely and independently. The following were excluded: children presenting a pre-

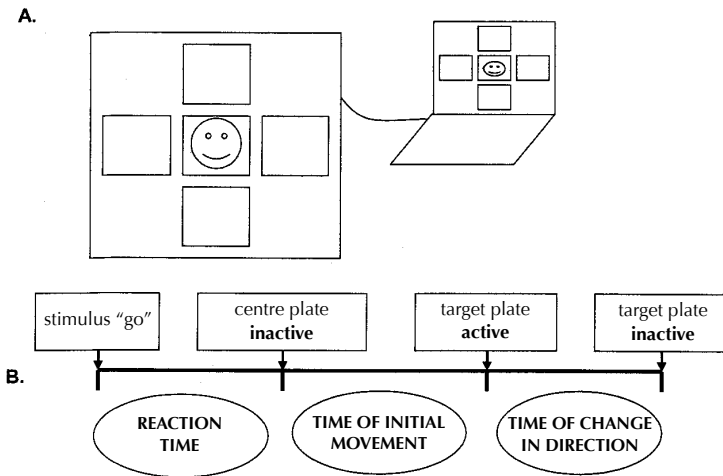
TABLE 1

Domain	Evaluation tool	Domain evaluated
Balance	Bruininks-Oseretsky Test of Motor Proficiency-Balance <sup>3</sup>	Static and dynamic balance without external perturbation[s]
	Postural Stress Test <sup>35</sup>	Responses to standardized external perturbations
	Pediatric Clinical Test of Sensory Integration for Balance <sup>7,34</sup>	Sensory interaction in static conditions
Visuomotor response time	Bruininks-Oseretsky Test of Motor Proficiency-Response Speed <sup>3</sup>	Simple response time with motor component limited to upper limb
	Mat with switches for evaluating response time	Simple, choice, and reversed choice response time, with motor response either limited to upper limb, or involving displacement of centre of gravity in whole body movement (see Figure 1)
Physical activity	Activity Rating Scale <sup>27</sup> (measure for matching physical activity level)	General level of participation in physical activity
	Physical Activity Questionnaire for children or adolescents <sup>6</sup>	Level of participation in usual physical activities
	Athletic Competence subscale of the Self-Perception Profile for Children or Adolescents <sup>18,17</sup>	Child's perception of his or her overall level of athletic competence
	Self-efficacy questionnaire developed for this study	Level of child's confidence in his or her immediate abilities to produce results (performance) in context of specific physical activities (see Appendix A)
Post-concussion symptoms	Rivermead Post-Concussion Symptoms Questionnaire <sup>20</sup>	Presence and severity of 16 recognized post-concussion symptoms

injury condition affecting motor performance, such as a neuromuscular, musculo-skeletal or cardiovascular disorder restricting the assessment, a documented pre-injury medical diagnosis of learning difficulties or attention deficit with or without hyperactivity and regular use of Ritalin. Children were also excluded if they attended a special school for learning difficulties or behaviour problems, or presented a fracture or comorbidity (nerve damage, lacerations, etc.) restricting the assessment of motor performance. The criteria for inclusion and exclusion (apart from the MTBI diagnosis) were the same for the control group children. Subjects in the MTBI group were recruited at the time they were admitted to the trauma program at the Montreal Children's Hospital (McGill University Health Centre). Wherever possible, control group subjects were recruited among the friends of MTBI subjects in order to control as many pre-injury variables as possible.

A number of measures of balance, response time and physical activity were used in this study, so as to obtain as many indicators as possible about the specific aspects of the domains studied that could be affected by the injury. The measures are listed in Table 1.

FIGURE 1



**Legend**

A. The device consists of a mat (1.5m x 1.5m) with 5 pressure plates with an on/off switch connected to a laptop computer monitor displaying the same configuration of targets as the mat.  
 B. The child is standing on the centre plate. The targets on the computer screen light up in a random sequence, and the child has to respond by jumping feet together towards the target on the mat corresponding with the one lit up on screen and return as fast as possible to the centre target. This completes one sequence and initiates the illumination interval of the next target. The sequence is repeated for 16 trials and comprises 4 random directions (forward, back, sides) and 4 different activation intervals (1 to 4 s.). The computer is programmed to record the reaction time and movement time in milliseconds. A similar mat was developed to assess response times when the response is limited to the upper limb.

## Balance

The main hypothesis concerning balance skills was that if deficits were identified, they would be more dynamic than static, and more complex than simple in terms of sensory interactions, as found in the exploratory study conducted by the authors.

### *Visuomotor response time*

The main hypothesis of this part of the study was that longer response times would be observed during the more complex tests involving a motor response by the whole body than during the simpler tests restricted to the upper limbs.

### *Physical activity*

Because this study was the first to focus on the return to physical activities following an MTBI in children, it involved exploring this domain rather than posing *a priori* hypotheses.

### *Post-concussion symptoms*

To assess post-concussion symptoms (PCS), the Rivermead Post-Concussion Symptoms Questionnaire was administered to the children in both groups, in order to document both the *presence* and the *severity* of the 16 recognized PCS (e.g. nausea or dizziness).

### *Procedure*

Balance, response times and PCS were assessed 1, 4, and 12 weeks after the MTBI. These times were chosen for evaluation based on their importance in the recovery process. Four weeks marks the end of the period of restricted activity required by the treatment program,<sup>32</sup> and 12 weeks is reported as the point at which most deficits have resolved.<sup>23,4</sup> The questionnaires evaluating level of participation in physical activity, perception of athletic competence, and self-efficacy related to physical activities were administered the day after the injury, in order to obtain a pre-injury profile of the child, and administered again 12 weeks after the MTBI. All the assessments took place in the child's home, to reduce the travelling involved and absence from school.

### *Statistical analyses*

To verify the study hypotheses, the children's performances on the various tests were compared using 2-way ANOVAs (group and time) with repeated measures for the time factor. The differences between the groups at each evaluation were determined with "t" tests for independent groups with corrections, and the time effect for each group was determined using 1-way ANOVAs for repeated measures

with Bonferroni corrections for the contrasts. To identify sub-groups of children with more severe deficits, relationships were calculated between the variables associated with the severity of the injury and the children's performances on the various tests (chi-squared analyses or Spearman correlations, as appropriate). Version 10.0 of the SPSS statistical analysis software was used for all analyses.

## Results

### *Balance*

Differences between the 2 groups were only identified in the performances on the Bruininks-Osteretsky Test of Motor Proficiency (BOTMP) and the Postural Stress Test (PST).<sup>13</sup> On the BOTMP, children who had sustained an MTBI, although they improved during the evaluation period ( $p=0.009$ ), presented lower performances than the control group children in the 3 evaluation sessions ( $p=0.001-0.02$ ). On the PST, the injured children were more easily destabilized than the control group children at the 1<sup>st</sup> and 12<sup>th</sup> week ( $p=0.024-0.027$ ).

### *Visuomotor response time*

The MTBI children displayed an increase in response time on the BOTMP at the first evaluation of only ( $p<0.001$ ) when compared with the control group children.<sup>11</sup> The children's performances on the response time equipment did not reveal any difference between the 2 groups. However, an upward trend in movement time was observed for the most complex conditions (reversed choice response time for lower limbs) ( $p=0.026-0.173$ ).

### *Physical activity*

In the domain of physical activity, the children in both groups presented comparable levels of participation in physical activities and perception of their athletic competence at both the initial evaluation (representing the pre-injury level) and the 12-week assessment. On the other hand, both groups had similar levels of self-efficacy related to physical activities on the initial evaluation, but MTBI children displayed decreased self-efficacy at the 12<sup>th</sup> week after MTBI.<sup>31</sup>

### *Post-concussion symptoms*

A significant difference was identified between the groups at all times. The MTBI children presented more symptoms than the control group children at each evaluation point ( $p=0.001-0.005$ ),<sup>13</sup> though significant improvement was observed between the 1<sup>st</sup> and 12<sup>th</sup> week ( $p=0.001$ ). With respect to the nature of symptoms, close to 58% of the MTBI children complained of being more fatigued than before the injury, and 42% complained of headaches at the assessment one week after the injury. These percentages dropped to 16% and 13% respectively at the 12-week

evaluation. Interestingly, these findings were similar to those in the adult MTBI population. Control group children reported only negligible symptoms at all the evaluations.

### *Relationships between variables*

In investigating the relationships between the deficits and certain characteristics of MTBI, we wanted not only to explore various avenues for interpreting the results, but also to determine the possibility of identifying a sub-group of children particularly likely to develop problems. With respect to balance, performance on the BOTMP tests one week after injury correlated with the severity of the MTBI (i.e. concussion grade) sustained by the children ( $p=0.01$ ) and the PCS measured at the same assessment ( $p=0.04$ ). A relationship was also established between the children's self-efficacy level after MTBI in the section of the questionnaire dealing with MTBI-related problems at the 12-week assessment and their performance on the PST, one of the balance tests, 4 weeks post-injury ( $p=0.035$ ). Performance on the response time tests bore no relation to the characteristics of the MTBI or PCS. For physical activity variables, the level of self-efficacy 12 weeks after the MTBI was negatively correlated with the PCS present at 4 and 12 weeks post-injury ( $p=0.008-0.009$ ).

## **Discussion**

The objective of this study was to examine prospectively the sequelae of MTBI in children. We identified balance problems and PCS that improved during the assessment period but persisted until the 12<sup>th</sup> week. Response time increases of a more transient nature were also identified, but only in the first week post-injury. At 12 weeks, children who had sustained a MTBI had returned to their pre-injury level of physical activity and maintained their perception of athletic competence. However, they displayed decreased self-efficacy related to physical activities compared with both the control group children and their own pre-injury levels.

Tests on which balance deficits and response time deficits were identified should be examined more closely. The tasks on which MTBI children displayed poorer performance than the control groups were usually the most *complex* and the ones in which the components of each are tested in *combination*. For example, the elements of the BOTMP identified as problematic in terms of balance tasks were those where the child had to remain standing on a restricted (i.e. narrow) support surface, in combination with either the absence of visual cues (i.e. eyes shut) or the performance of tasks requiring a high degree of coordination. Findings were similar for tasks where response times were higher for the MTBI children. In other words, the situations in which deficits were identified were complex not only in terms of information processing or motor response, but also when both components were present in conjunction with each other. It is therefore hardly surprising

that these deficits go unnoticed during more straightforward clinical assessments that only examine one aspect at a time or during the neurological screening undergone by these children when they are released from hospital.

The visual stimulus used in the response time task on the BOTMP, which appears to be a simple response time test, does not seem to corroborate the above finding. However, because this stimulus is characterized by movement (ruler falling to the floor) rather than luminance (light coming on), it represents a higher level of complexity, requiring a higher level of information processing.<sup>8</sup> This method, testing visuomotor response time using dynamic visual stimuli, is potentially a novel approach for assessing individuals post-MTBI and could help to clarify the nature of the response time deficits observed.

The most innovative result of the research in the field of MTBI concerns the study of the concepts of self-efficacy in physical activity and the perception of athletic competence in children following MTBI. This is the first study focusing on these issues and looking at the resumption of physical activities in greater depth than simply determining the point at which it is safe. The preliminary development of a tool focusing on self-efficacy in physical activity post-MTBI is a useful contribution for the advancement of research in this field. This tool appears promising because of its stability during the 12-week period with the control group, in which major variations of self-efficacy were not anticipated, and because of its ability to identify the differences between the groups 12 weeks post-MTBI. The second useful aspect is that the identified psychosocial deficit involved self-efficacy in performing specific physical activities, not the perception of overall athletic competence. Since the triggers for this research included comments by MTBI children that they did not feel the same as before the injury when engaging in physical activities, translating these feelings into measurable deficits is of particular value. Clearly the follow-up period was only short-term (12 weeks), and data on what subsequently transpired is not available. However, given that the children were extremely active when engaging in their physical activities, as measured by the Physical Activity Questionnaire at the 12-week assessment, addressing diminished self-efficacy at this point remains relevant. Self-efficacy is a complex concept; in line with the findings on the nature of motor deficits described in the previous section, this complexity aspect may characterize all the deficits identified post-MTBI in children.

The level of participation in physical activity was maintained 12 weeks after the MTBI as compared with the immediate pre-injury period. Clearly the deficits identified in the domains of balance, reaction time and self-efficacy do not affect the child's decision to take part in his or her usual physical activities. The question now is whether other aspects of physical activity, such as performance, are worth examining following an MTBI.

With respect to the relationships between the characteristics of the MTBI and the child's performance on the various tests, we are unable to conclude that specific

characteristics can predict deficits in every domain. However, balance deficits seem to be linked to the severity of the MTBI, and PCS to impaired balance and self-efficacy deficits. The relationship between the performance of MTBI children on the PST at 4 weeks and the feeling of self-efficacy during physical activity at 12 weeks is particularly interesting. Balance deficits identified 4 weeks after the MTBI are observed at the very time when children are allowed to resume their physical activities (end of restricted activity period) and thus start to form an opinion about their self-efficacy after the injury. The PST balance test assesses the integrity of reactions to external perturbations. External perturbations may well be present during physical activities. Difficulties in reacting appropriately when they occur may affect children's initial performance in these activities. These performances are used in forming a judgment of their self-efficacy<sup>2,1</sup> and will likely contribute to lowering it, as observed 12 weeks post-MTBI.

Inevitably, this study has the inherent limitations of any clinical research project, and the results should be viewed with these limitations in mind. Certain tools developed for adults had never been used with a child population. Although we demonstrated that using them with this clientele was feasible and their sensitivity in identifying certain deficits appears to validate this use, the fact remains that the lack of psychometric characteristics and norms specific to children or to MTBI children is a limitation when it comes to interpreting the results. In addition, children were recruited exclusively from a hospital population, with all the potential biases this entails (e.g. specific geographic region, symptoms more severe). It is acknowledged that up to 25% of all incidences of MTBI are never reported,<sup>29</sup> and the recruitment method certainly played a part in limiting the generalizability of the results to all cases of children who sustain an MTBI. The sample size could also be regarded as limiting generalizability of the results. However, since the number of subjects necessary was calculated a priori in order to ensure reasonable power in detecting differences between the groups, it may be assumed that the differences identified are real, at least for the main outcome measure, the BOTMP. Another limitation is the limited period during which the children were followed. The persistence of certain deficits at the end of the 12-week period makes us wonder about their subsequent evolution. A minimum 6 to 12 months of follow-up is strongly recommended for future studies examining the same type of deficits post MTBI.

The identification of new deficits following an MTBI raises a few questions regarding clinical practice with children who have sustained this type of injury. Undoubtedly the most obvious is whether or not to conduct systematic assessments of the domains in which deficits are identified. Pursuing research in this area will provide more comprehensive answers, but certain recommendations may already be made. Introducing routine assessments of certain aspects involving balance, response time, and self-efficacy would be justified, particularly at the point when physical activities are resumed (2 to 4 weeks post-MTBI), in order to identify

children who require more specific monitoring as a result of MTBI. With respect to balance and response time, complex tasks like the BOTMP balance and response time sub-tests may be sufficiently sensitive to provide reliable indicators of the presence of deficits in these domains. As regards self-efficacy, the questionnaire developed in this research is the only one available, so further study to validate the tool is recommended; at the same time, it should be routinely used for determining the pre-injury level of self-efficacy and documenting its post-injury evolution.

Also to be examined is the question of what intervention to recommend for treating newly identified deficits in this clientele. Initially, the specific and probably transitory nature of both motor and psychosocial deficits reported in our research, and their improvement over time, may require an approach acknowledging that the problems exist and reassuring children that they will resolve in a matter of weeks. Studies of interventions with PCS using this type of approach demonstrate a degree of efficacy.<sup>19,33</sup> Since current practice with these children in the Montreal Children's Hospital trauma program already involves telephone contact 4 weeks after the MTBI, to make sure that things are generally progressing positively, it may be feasible to add this type of intervention for children presenting more specific difficulties in the domains studied. Finally, the attitude of clinicians when dealing with children is definitely important. Minimizing the importance of the effects of MTBI will only compound the child's sense of bewilderment when things do not return to normal immediately. If reassurance does not help, specific motor or psychological interventions may be worth exploring, but their importance should not be over-emphasized.

Further research is needed to clarify the severity and impact of the newly identified deficits in this study. The findings suggest that some children present balance, response time and self-efficacy problems in addition to PCS that persist beyond the period in which physical activity is curtailed. These impairments may affect not only their performance but also their safety when they resume physical activities. In this context, the current restrictions should be used with care, especially when children return to physical activities that require complex skills in terms of balance and visuomotor response time.

## Acknowledgments

This project received funding from the *Réseau provincial de recherche en adaptation-réadaptation*, the *Fondation Marie-Robert*, the *Ordre professionnel de la physiothérapie du Québec* and the Physiotherapy Foundation of Canada. Three of the authors (Gagnon, Swaine and Forget) received funding from the *Fonds de la recherche en santé du Québec*.

We wish to thank the Montreal Children's Hospital trauma team, especially Debbie Friedman, Allan Ptack and Carlo Galli, for their exceptional collaboration.



Special thanks go to Lisa Grilli and Cathy Rossi for their professionalism and constant availability for child assessments.

We also extend our thanks to the entire CRIR team at the Institut de réadaptation de Montréal site for always being available and providing invaluable assistance at every stage of the project.

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APPENDIX A

**Self-efficacy questionnaire<sup>1</sup>**

Thinking about the activities you chose in the physical activity questionnaire, today (or before the accident, for the initial evaluation), how confident are you that you can achieve the following.

**Items related to MTBI problems**

In the activities that I chose, I believe that if I want to I can...

- |    |   |                    |    |    |    |                      |    |    |    |                |     |
|----|---|--------------------|----|----|----|----------------------|----|----|----|----------------|-----|
| 1. | play by myself without falling or hurting myself                          | 10                 | 20 | 30 | 40 | 50                   | 60 | 70 | 80 | 90             | 100 |
|    |   | not very confident |    |    |    | moderately confident |    |    |    | very confident |     |
| 2. | participate in all the activities without having a headache               | 10                 | 20 | 30 | 40 | 50                   | 60 | 70 | 80 | 90             | 100 |
|    |   | not very confident |    |    |    | moderately confident |    |    |    | very confident |     |
| 3. | participate in all the activities without feeling more tired than usual   | 10                 | 20 | 30 | 40 | 50                   | 60 | 70 | 80 | 90             | 100 |
|    |   | not very confident |    |    |    | moderately confident |    |    |    | very confident |     |
| 4. | react quickly when I have to  | 10                 | 20 | 30 | 40 | 50                   | 60 | 70 | 80 | 90             | 100 |
|    |   | not very confident |    |    |    | moderately confident |    |    |    | very confident |     |
| 5. | play with my friends without having to rest more than usual               | 10                 | 20 | 30 | 40 | 50                   | 60 | 70 | 80 | 90             | 100 |
|    |   | not very confident |    |    |    | moderately confident |    |    |    | very confident |     |
| 6. | play with my friends without falling or hurting myself                    | 10                 | 20 | 30 | 40 | 50                   | 60 | 70 | 80 | 90             | 100 |
|    |   | not very confident |    |    |    | moderately confident |    |    |    | very confident |     |
| 7. | participate in the activities without my muscles hurting or feeling sore  | 10                 | 20 | 30 | 40 | 50                   | 60 | 70 | 80 | 90             | 100 |
|    |   | not very confident |    |    |    | moderately confident |    |    |    | very confident |     |
| 8. | participate in the activities without being more out of breath than usual | 10                 | 20 | 30 | 40 | 50                   | 60 | 70 | 80 | 90             | 100 |
|    |   | not very confident |    |    |    | moderately confident |    |    |    | very confident |     |

1. Questionnaire on self-efficacy developed for this study using the conceptual framework of Bandura (1986) and a recognized procedure (Streiner & Norman, 1989) for defining the child's confidence level and their immediate capacities to produce results (performance) in the context of specific physical activities.

**Items related to athletic competences**

In the activities that I chose, I believe that if I want to I can...

1. do well when I can play by myself  
 10    20    30    40    50    60    70    80    90    100  
 not very confident                      moderately confident                      very confident
2. do well when I have to be part of a team  
 10    20    30    40    50    60    70    80    90    100  
 not very confident                      moderately confident                      very confident
3. do well if I know that other kids are watching  
 10    20    30    40    50    60    70    80    90    100  
 not very confident                      moderately confident                      very confident
4. participate in these activities so that my parents will be happy  
 10    20    30    40    50    60    70    80    90    100  
 not very confident                      moderately confident                      very confident
5. participate in these activities so that I am happy with my performance  
 10    20    30    40    50    60    70    80    90    100  
 not very confident                      moderately confident                      very confident
6. participate in these activities so that my coach or my teammates are happy with my performance  
 10    20    30    40    50    60    70    80    90    100  
 not very confident                      moderately confident                      very confident
7. participate without being afraid that others will laugh at me  
 10    20    30    40    50    60    70    80    90    100  
 not very confident                      moderately confident                      very confident
8. know that I will be picked first when we have to make teams to play certain games  
 10    20    30    40    50    60    70    80    90    100  
 not very confident                      moderately confident                      very confident
9. always give my 100% when I participate  
 10    20    30    40    50    60    70    80    90    100  
 not very confident                      moderately confident                      very confident
10. be as good as usual when I participate in these activities  
 10    20    30    40    50    60    70    80    90    100  
 not very confident                      moderately confident                      very confident



# Premorbidity and mild traumatic brain injury in adults

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**SUMMARY** – This study investigates the origin of symptoms observed in adults who have experienced mild traumatic brain injury (MTBI). Specifically, it examines the effect of psychological, neurological, or educational antecedents on subjectively reported symptoms and on the results of simple and complex tests of memory and attention. The participants, individuals aged 16 to 64 who had sustained MTBI, were divided into 2 groups. Subjects in the first group had antecedents, while subjects in the second had none. A third group consisted of control subjects. Significant differences were observed between MTBI participants and control subjects on the subjective evaluation questionnaire and attention tests. No significant differences could be shown in MTBI participants' performance in terms of the presence or absence of antecedents. On the other hand, only MTBI participants with antecedents differed from MTBI participants without antecedents and control subjects on certain variables in the memory test. The results support the links between diffuse cerebral damage and attention deficits following MTBI and a differential effect of antecedents on cognitive function.

**KEYWORDS** – mild traumatic brain injury, antecedents, premorbidity, attention, working memory, memory and learning, executive functions

## Introduction

In the wider field of brain injury, mild traumatic brain injury (MTBI) is probably the least well understood. Yet its incidence in industrialized countries ranges annually from 200 to 450 cases per 100,000 people.<sup>13</sup> This type of injury accounts for approximately 2/3 of traumatic brain injury (TBI) diagnoses.<sup>17</sup> In the United States, the 325,000 people who consult every year for MTBI account for some 80% of TBI cases.<sup>8</sup> Every year nearly 2,000 individuals sustain MTBI in Quebec.<sup>23</sup>

Etiology varies with age. Falls are more frequent in the elderly, while younger people are more likely to be involved in motor vehicle accidents.<sup>32</sup> Studies show that nearly half the people involved are aged 15 to 34, and twice as many men as women are estimated to sustain MTBI.<sup>31</sup>

MTBI symptoms extend over a period of a few weeks to a few months after the injury.<sup>19</sup> Alexander<sup>1</sup> has proposed the term “post-concussive syndrome” (PCS) to describe the symptoms observed during this period. In many MTBI patients, most of these symptoms dissipate during the months following the accident.<sup>2,4,14,19,34</sup> However, a small group complain of recurring or persistent symptoms over a longer period.<sup>10,15,16,18,33,35</sup>

The sequelae associated with MTBI vary from one individual to another and over time. They are usually classified into 3 categories: physical, emotional or behavioural, and cognitive. This article focuses mainly on cognitive sequelae (attention and concentration, memory problems and executive dysfunction).

However, there is still only a fragile consensus that deficits following MTBI are of purely neurological origin. Some authors<sup>5,33</sup> believe they are linked to psychological or psychosocial factors. Others<sup>21</sup> believe that neurological factors, including diffuse axonal damage (DAD), may explain the appearance of symptoms. Some authors who recognize that PCS is initially of organic origin believe persistence of symptoms is linked to psychological factors.<sup>16</sup> Finally, other authors have suggested the possible impact of certain antecedents (e.g. alcoholism, multiple MTBI or learning disabilities) on cognitive function in MTBI patients.

Certain researchers have examined the histories of MTBI subjects and recorded more antecedents in this clientele. Fenton *et al.*<sup>12</sup> found a larger number of unfavourable life events in an MTBI group compared with control subjects. Binder<sup>5</sup> concluded that MTBI participants in his study had more psychosocial problems prior to the injury compared with control subjects. Cohadon *et al.*<sup>7</sup> demonstrated that persistent PCS, almost always including incapacity to resume work, was strongly correlated with psychosocial risk factors predating the injury.

These studies show that more antecedents are found in these subjects. However, viewing antecedents as the origin of the symptomatology following an MTBI remains questionable. Individuals with more antecedents may well be at greater risk for MTBI. That does not imply more extensive symptomatology in these individuals post-injury. Moreover, most authors addressing this issue have focused



on subjective evaluation. The exceptions are Cicerone and Kalmar,<sup>6</sup> who examined the involvement of premorbid emotional disturbance in the persistence of PCS symptoms and neuropsychological function subsequent to MTBI. They compared a group of MTBI participants with depressive antecedents and a group of MTBI participants with no antecedents. In addition to a subjective evaluation of symptoms following MTBI, Cicerone and Kalmar used cognitive tests to measure attention, memory and executive function, as well as a personality test (MMPI). No difference was observed between the groups with respect to physical, cognitive, and emotional problems post injury or in the results of psychological and neuropsychological (cognitive) testing.

### Study goal and hypothesis

Despite the belief that antecedents influence MTBI symptomatology, very few studies have addressed this issue from an empirical perspective.

The aim of this study was to examine the effect of psychological, neurological or educational antecedents on the subjective and objective performance of adults with MTBI. It was proposed that MTBI participants with antecedents prior to the injury would display a higher number of subjective symptoms as well as lower performance on complex memory and attention tests, compared with both MTBI participants with no antecedents and control subjects.

## Methodology

### *Subjects*

Participants in this study were all individuals who reported to a regional hospital emergency room after sustaining an MTBI. The sample came from a longitudinal study by Nolin *et al.*<sup>25</sup> in which participants were evaluated 3 times: 1) in the 24 hours following injury; 2) 3 to 4 months after MTBI; 3) more than 12 months after MTBI. The results in this article were collected during the second phase of the research.

Diagnostic criteria were those of the MTBI sub-committee of the Head Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitation Medicine.<sup>22</sup> MTBI is defined as:

a traumatically induced disruption of physiological brain function, arising from acceleration, deceleration or rotation forces to the head, as manifested by at least one of the following: any period of loss of consciousness, any loss of memory about events immediately before or after the accident, any alteration in mental state at the time of the accident (feeling dazed, disoriented or confused), focal neurological deficit(s) that may or may not be transient, but where the severity of the injury does not exceed the following: loss of consciousness of approximately 30 minutes or less, Glasgow coma scale of 13 to 15 after 30 minutes, and post-traumatic amnesia not greater than 24 hours.

Participants also had to be 16 to 65 years of age, with no neurological complications.

Based on these criteria, 246 subjects were seen in the first phase of the study. Of these, 123 people aged 16 to 96 took part in the second part of the study. The age criterion, reflecting the known effects of aging on cognitive and psychological function, resulted in the exclusion of 7, bringing the sample for this study to 116 MTBI subjects. Certain participants did not complete all the neuropsychological tests. For this reason, the number of MTBI participants varies from 91 to 116, depending on the measure used for the statistical analyses.

Distribution of MTBI etiology was as follows: 50% associated with a motor vehicle accident, 17% associated with an occupational accident, 12% associated with a sports accident, 9% occurring at home, and 12% associated with miscellaneous causes (e.g. a participant on the way home injured by falling ice). The sample was 65% men and 35% women, about the same proportions as samples in the literature.

A questionnaire<sup>26,20</sup> was used to classify antecedents and assign MTBI participants to one of three families of antecedents developed to meet the study objectives. The first family of antecedents included the following psychological components: risk-taking, delinquency, recklessness, depression, suicide attempt, bipolar disorder, electroconvulsive therapy, hospitalization in a psychiatric setting, treatment for mental disorders, psychological monitoring, alcoholism, and drug addiction. The second family of antecedents included the following neurological components: migraines, severe headaches, meningitis, encephalitis, TBI, fractured skull, cerebral vascular accident (CVA), and multiple sclerosis. The third family of antecedents comprised the following educational components: hyperactivity, repeating one or more grades, learning disabilities, and special education. MTBI participants were assigned to one of the families of antecedents when they gave a positive answer to one of the components in a given family. For example, a participant who reported suffering from depression that predated the MTBI was placed in the “psychological antecedents” group. Distribution of participants by family of antecedents is shown in Table 1. Distribution of participants according to Glasgow Coma Scale results is found in Table 2. Both clinical groups (MTBI with and without antecedents) were homogenous for this variable [ $X^2(1, N=116) = 4.96, p>.05$ ].

A group of 30 control subjects was used for comparison with MTBI participants (with and without antecedents) on the various attention tests. The results show the homogeneity of the 3 groups based on the criteria selected. The 3 groups were homogenous in terms of age [ $F(2, 143) = 0.71, p>.05$ ] and gender [ $X^2(2, N=146) = 3.03, p>.05$ ]. A group of 90 control subjects was also used for comparison with MTBI participants (with and without antecedents) on the different memory and learning variables. The results show the homogeneity of the 3 groups in terms of gender ( $x^2(2, N=198) = 2.65, p>.05$ ) and age ( $F(2, 195) = 0.33, p>.05$ ). These participants were administered the same general information questionnaire and

TABLE 1  
**Distribution of MTBI participants by psychological,  
 neurological and educational antecedents**

Family of antecedents	Percentage	Number of participants
No antecedents	21%	25
Psychological	11%	13
Neurological	9%	10
Educational	8%	9
Psychological and neurological	7%	8
Psychological and educational	11%	13
Neurological and educational	6%	7
Psychological, neurological and educational	27%	31

TABLE 2  
**Distribution of MTBI participant scores on the Glasgow Coma Scale**

Group	Glasgow Coma Scale		
	13	14	15
Without antecedents	4 (16%)	6 (24%)	5 (60%)
With antecedents	13 (14%)	12 (13%)	66 (73%)

underwent the same neuropsychological tests as participants in the clinical groups. The general information questionnaire also served to screen out antecedents in the control groups and exclude cases of MTBI.

## Instruments

### *Subjective evaluation*

The subjective evaluation questionnaire on MTBI<sup>27</sup> was used to list and classify symptoms present at the time of the assessment. It listed 96 symptoms, of which 48 were typical symptoms (emotional, cognitive and physical) and 48 non-typical symptoms of PCS. Participants were asked indicate whether each symptom was present. Symptoms reported had to have appeared at the time of the MTBI and still be present at the time of the assessment. Symptoms present before the accident or attributable to a cause other than the injury were excluded, to ensure that only MTBI symptomatology was recorded. For the symptom count, a result was recorded for each of the 3 symptom families (cognitive, emotional and physical), as well as a total for all typical symptoms of PCS. The scale of non-typical symptoms was not used in this study.

### *Attention tests*

The PASAT<sup>14</sup> was used as a complex measure of attention and working memory. The test was administered in 3 sessions during which participants heard a tape playing a series of numbers recited at 3 different speeds, depending on the trial (2.4 sec., 2.0 sec., and 1.6 sec.). Participants were asked to add the pairs of numbers and give their reply verbally. They were required to add the last number of the preceding pair to the next number on the recording. This was repeated for the 61 numbers in the series. The total score for each trial was obtained from the number of correct answers given.

To validate performances on the PASAT, a simple calculation task was used as a control variable. Participants were asked to perform a series of 10 easy calculations, and their score of correct answers out of 10 was recorded.

The Stroop Color Word Test<sup>36</sup> was used to measure selective attention and flexibility. When the first card is presented, participants are asked to read the name of the colours, which are printed in black. On the second card, participants must read the colour of the rectangles. On the third card, participants state the colour of the ink in which the name of the colour is printed, instead of reading the word. On the fourth card, participants repeat the exercise for the previous card but have to read the word if a color is in a box. The dependant variable used is participants' execution time for each of the 4 cards.

The Auditory Consonant Trigrams Test<sup>30</sup> was used to evaluate divided attention and sensitivity to interference. The test is performed as follows: the evaluator recites a cluster of 3 letters to participants, who are told to remember them; the evaluator then gives the subjects a number from which they must count backwards by threes. When signalled to do so by the evaluator, participants stop counting and recite the 3 letters. The time that elapses between the moment when participants hear the letters and have to answer varies; 4 intervals are mixed: 0, 9, 18 and 36 seconds. The dependent variable is the number of correct series reported for each of the 4 intervals.

### *Measurement of memory and learning*

The French version<sup>24</sup> of the California Verbal Learning Test (CVLT)<sup>9</sup> is widely used to assess learning and memory capacity. The CVLT consists of a list of 16 words (list A), in 4 semantic categories (flowers, clothes, fish, and fruit). The list is read 5 times to participants, who must recall as many words as possible each time. This first stage is used to evaluate the learning curve and calculate the total for the 5 trials. An interference list of 16 words is then presented (list B). Proactive interference is present when a first learned task (list A) affects the second one (list B). This task is followed by immediate free recall of the words on list A, then cued recall. Twenty minutes later, free and cued recalls are performed to verify retention of information over time, and increased recall from cueing with semantic clusters.

Finally, participants perform a recognition task which involves identifying the 16 list A words among a number of distractors. It is possible to count the number of semantic clusters (when 2 consecutive words from the same category are recited), the number of perseverations (repetition of a word), and the number of intrusions (evocation of a word not on the list).

## Results

### *Subjective measures*

Kruskal-Wallis non-parametric analyses were used to compare the results for the subjective questionnaire according to whether the participants were in the MTBI without antecedents group (group 1) or the MTBI group with antecedents (group 2). The analyses showed no significant difference in total number of symptoms reported for cognitive, emotional or physical symptoms. Both MTBI groups thus reported similar quantities of symptoms for each of the 3 categories (see Table 3).

TABLE 3

**Mean and standard deviation of symptoms in groups 1 and 2 on scales in questionnaire on subjective evaluation of MTBI symptoms, and results of group comparison analyses**

Variable	Group 1 (n=24)	MTBI without antecedent		Group 2 (n=75)	MTBI with antecedents		K-W
	Mean ranking	M	SD	Mean ranking	M	SD	
Total quantity of symptoms	44.71	13.16	9.77	47.59	14.76	11.04	0.17 <sup>N/S</sup>
Emotional symptoms	48.68	3.00	2.29	46.57	2.99	2.94	0.10 <sup>N/S</sup>
Cognitive symptoms	44.63	4.21	4.58	48.23	4.44	3.92	0.27 <sup>N/S</sup>
Physical symptoms	43.32	5.95	4.27	48.56	7.33	5.66	0.56 <sup>N/S</sup>

N/S: Non-significant

As regards the frequency with which PCS symptoms appear, taken individually, the results show no significant difference overall between the 2 groups, except for the symptom “difficulty falling asleep”, which is reported more frequently, [ $X^2(1, N=94) = 4.81, p=.03$ ], by MTBI participants with antecedents.

### *Attention measures*

The results of the covariance analysis showed that the calculation task does not significantly affect the performance of participants on trial 1 and trial 3 of the

PASAT, but does affect performance on trial 2. The variance analysis highlighted significant differences between the 3 groups (group 1: MTBI with no antecedents; group 2: MTBI with antecedents; group 3: control) with respect to the 3 PASAT tests, while the contrast analyses enabled us to qualify these differences as being between the 2 MTBI groups on the one hand and the control group on the other. In other words, the performances of MTBI patients were significantly different from those of control subjects, though no difference could be identified between the 2 clinical groups (see Table 4).

TABLE 4

**Mean and standard deviation on PASAT tests 1, 2 and 3 for participants in the three groups, and results of group comparison analyses**

Variable	Group 1 MTBI without antecedent (n=20)		Group 2 MTBI with antecedents (n=71)		Group 3 Control (n=30)		F Covariate	F Multivariate
	M	SD	M	SD	M	SD		
Test 1	39.15	10.69	36.55	13.36	48.50 <sup>a</sup>	9.43	3.15	14.31**
Test 2	34.68	13.23	31.94	12.12	44.90 <sup>a</sup>	9.90	9.36*	
Test 3	27.64	11.45	24.10	12.56	38.17 <sup>a</sup>	7.50	2.71	

a: indicates that mean is significantly different from other means based on LSD contrast analysis (p<.05)

\*: p<.05

\*\* : p<.01

Analysis of the data in Table 5 showed a significant difference as regards cards 1, 3 and 4 of the Stroop Color Word Test, whereas this difference was not observed for card 2. MTBI subjects scored slower execution times than control subjects. There was no significant difference between the 2 MTBI groups.

Table 6 compares the number of correct series reported for the 3 groups on the Auditory Consonant Trigrams Test. The analyses showed that the mean number of correct series reported by the 3 groups was comparable for interval 0. However, significant differences were observed for the intervals of 9, 18, and 36 seconds between the control group and the MTBI groups with and without antecedents. No significant difference was found between the participants in the 2 MTBI groups.

This data indicates that control group scores are better on the PASAT, the Stroop Color Word Test and the Auditory Consonant Trigrams Test, but that the tests do not differentiate between MTBI participants with or without antecedents.

TABLE 5

**Mean and standard deviation on Stroop Color Word Test for participants  
in the three groups and results of group comparison analyses**

Variable	Group 1 MTBI without antecedent (n=25)		Group 2 MTBI with antecedents (n=91)		Group 3 Control (n=30)		F Multivariate
	M	SD	M	SD	M	SD	
Results for card 1	71.26	18.84	66.92	19.08	41.17 <sup>a</sup>	7.05	28,89***
Results for card 2	48.36	8.54	50.83	14.65	49.60	5.44	
Results for card 3	117.32	32.56	123.20	51.45	90.07 <sup>a</sup>	8.15	
Results for card 4	128.90	32.80	137.85	57.55	99.83 <sup>a</sup>	5.69	

a: indicates that mean is significantly different from other means based on LSD contrast analysis ( $p < .05$ )

\*\*\*:  $p < .001$

TABLE 6

**Mean and standard deviation on the Auditory Consonant  
Trigrams Test and results of group comparison analyses**

Variable	Group 1 MTBI without antecedent (n=25)		Group 2 MTBI with antecedents (n=91)		Group 3 Control (n=30)		F Multivariate
	M	SD	M	SD	M	SD	
Interval 0 sec.	2.83	0.49	2.67	0.77	2.90	0.31	16.34***
Interval 9 sec.	1.83	0.89	1.60	1.08	2.70 <sup>a</sup>	0.47	
Interval 18 sec.	1.70	1.06	1.36	1.10	2.50 <sup>a</sup>	0.51	
Interval 36 sec.	1.55	0.96	1.36	1.08	2.63 <sup>a</sup>	0.49	

a: indicates that mean is significantly different from other means based on LSD contrast analysis ( $p < .05$ )

\*\*\*:  $p < .001$

## Memory test

### *Mnesic function*

The total for the 5 trials enabled us to compare mnesic capacity (see Table 7) for the 3 groups. Analysis revealed a significant difference between the groups. Contrast analysis showed that MTBI participants with antecedents differed significantly from MTBI participants without antecedents in terms of learning capacity.

TABLE 7

**Mean and standard deviation for memory and learning variables assessed by CVLT and results of group comparison analyses**

Variable	Group 1 MTBI without antecedent (n=22)		Group 2 MTBI with antecedents (n=86)		Group 3 Control (n=90)		F Univariate
	M	SD	M	SD	M	SD	
Total 5 Tests	59.77	7.86	53.29a	11.90	58.88	9.24	7.59***
Retention of information							
• Short delay	1.45	1.50	1.69b	1.91	0.93	1.81	3.81*
• À Long delay	0.59	1.33	1.07b	1.87	0.21	1.73	5.25**
Facilitation by cueing							
• Cueing-a	0.73	1.72	1.08	1.71	0.91	1.52	0.51
• Cueing-b	-0.05	1.21	0.47	1.39	0.35	1.06	1.53
Facilitation by recognition							
• Recognition-a	2.95	1.84	3.69b	2.73	2.64	2.30	3.96*
• Recognition-b	2.09	1.69	3.10b	2.66	1.91	2.15	5.75**

a: indicates that mean is significantly different from other means based on LSD contrast analysis ( $p < .05$ )

b: indicates that mean is significantly different from other means in Group 3 based on LSD contrast analysis ( $p < .05$ )

\*:  $p < .05$

\*\* :  $p < .01$

\*\*\*:  $p < .001$

Retention of information after a short interval was analyzed by subtracting the result of the immediate free recall from that of the fifth trial. There was a significant group effect; contrast analysis showed that the MTBI group with antecedents differed from the control group only.



The capacity to retain information for a long period was calculated by comparing the score on trial 5 with that on the delayed free recall. There was a group effect, and contrast analysis indicated that the difference was between the MTBI group with antecedents and the control group.

The CVLT provides information about the increase in recall based on semantic and recognition cues. First, the results of free recalls (immediate and delayed) were respectively compared with those for cued recalls (immediate and delayed), in order to measure the improvement generated by a category cue. The analyses suggest no significant difference between the groups, either following immediate cued recall or delayed cued recall. No group appeared to benefit from cueing by semantic category.

Facilitation of recall in a recognition task was then measured by comparing the free recall scores with those obtained on the recognition task. Variance analysis showed a significant difference between the groups when comparing immediate free recall to the recognition task and when comparing delayed free recall to the recognition task. Contrast analysis indicated that this difference was between the MTBI group with antecedents and the control group.

#### *Executive memory function*

No significant difference was found in the number of perseverations between the 3 groups (see Table 8). However, there was a marked difference in the number of intrusions. Contrast analysis demonstrated that in the MTBI group with antecedents, there were significantly more intrusions than in the MTBI group without antecedents or the control group.

Proactive interference occurs when a first learned item significantly affects capacities during subsequent learning.<sup>28</sup> Variance analysis was calculated by comparing the result of the first trial in list A with that for list B, the usual procedure in a clinical setting.<sup>28</sup> This did not show any group effect. Performance of all individuals appeared to diminish between list A and list B, without any significant difference between the groups.

Learning of words based on the order in which they are presented reflects an elementary strategy (i.e. self-repetition). Here the 3 groups displayed comparable performance. With semantic clusterings, a more elaborate and efficient strategy, variance analysis revealed a significant difference between the groups, particularly between the MTBI group with antecedents and the control group. In other words, the control group uses many more semantic clusters than the MTBI group with antecedents.

## **Discussion**

After analyzing the distribution of our MTBI subjects, we found that only 24.2% of participants had no antecedents. In addition, more than 75.8% of participants

TABLE 8

**Mean and standard deviation for executive memory functions  
assessed by CVLT and results of group comparison analyses**

Variable	Group 1 MTBI without antecedent (n=22)		Group 2 MTBI with antecedents (n=86)		Group 3 Control (n=90)		F Univariate
	M	SD	M	SD	M	SD	
Perseverations	5,68	6,11	5,40	3,88	4,89	4,21	0,46
Intrusions	1,09	2,04	4,00 <sup>a</sup>	4,61	2,07	2,58	9,22***
Proactive interference	2,09	1,77	1,17	2,21	0,89	2,41	2,50
Clustering							
• Serial	7,86	7,26	5,93	4,34	7,26	6,05	1,70
• Semantic	37,68	20,10	31,16 <sup>b</sup>	18,38	41,93	19,53	6,96***

a: indicates that mean is significantly different from mean for Groups 1 and 3 based on LSD contrast analysis ( $p < .05$ )

b: indicates that mean is significantly different from mean for Group 3 based on LSD contrast analysis ( $p < .05$ )

\*\*\*:  $p < .001$

had at least one. It is interesting to see how frequent antecedents are in this population. Very few participants (28.3%) had only one family of antecedents. Multiple antecedents, observed in 47.5% of participants, are common. Moreover, 32.3% of participants, nearly one-third of the study, mentioned the presence of previous MTBI. Antecedents therefore are a reality for this clientele. These results corroborate those of Binder,<sup>5</sup> Fenton *et al.*<sup>12</sup> and Cohadon *et al.*,<sup>7</sup> who also demonstrated a high incidence of various premorbid conditions among MTBI adult patients.

Overall, this study concurs with the view that symptomatology following MTBI is not greatly influenced by the presence of antecedents. These findings are in line with those of Cicerone and Kalmar,<sup>6</sup> who used several measures of psychological and cognitive function (objective and subjective measures) and failed to show a significant difference between groups with antecedents and without. Readers interested in subjective evaluation in this context will find more detailed information in one of our recent publications.<sup>3</sup>

The results suggest that MTBI results in genuine damage to function. Slowing down seems to be directly caused by neurological changes associated with MTBI. Participants in the MTBI group appear to find it harder to focus their attention deliberately on a relevant stimulus and ignore non-relevant stimuli. In addition, MTBI subjects seem to have less capacity for mental flexibility. MTBI therefore affects a person's ability to adapt to changes in the environment.

Paré *et al.*<sup>29</sup> also report greater sensitivity to interference among MTBI partici-

pants than the so-called normal population. MTBI participants seem to have less capacity to process 2 or more categories of relevant information. They also have more difficulty remaining alert, their cognitive processes do not perform as well, and they have less control over attention than control subjects. This last capacity stems from reasoning and problem-solving, which adds further weight to the above statement that MTBI triggers attention difficulties.

While the results suggest there is no link between antecedents and performance on complex attention tests, the combination of MTBI and antecedents causes significant mnemonic difficulties. Although the results are statistically significant, the small size of the MTBI group without antecedents makes the findings difficult to generalize. Further research is needed to confirm the results with a larger group of MTBI patients without antecedents. Moreover, because the results demonstrate that antecedents have a significant impact on mnemonic deficits, a distinction should be made between the different types of antecedents (neurological, psychological, social, and educational) and their respective impact on memory. Memory appears to be a function that is more sensitive to premorbid factors.

## Conclusion

The results of our study suggest we should be cautious in attributing MTBI deficits to the presence of antecedents. While this study explored some avenues, it did not tackle all the questions about the origin of MTBI symptoms. Future studies should incorporate improvement to address these limitations. For example, the same issue could be investigated using more participants; the role of antecedents could then be analyzed in greater depth. It would be preferable to compare participants by family of antecedents. In addition, we still need to verify whether similar results are obtained with MTBI patients reporting longer term symptoms. Finally, a control group with antecedents should be added, to provide a clearer understanding of how these factors influence neuropsychological testing. It would then be easier to take a stand in the current debate about the root of MTBI symptoms.

The results of this study remain compatible with those of Cicerone and Kalmar,<sup>6</sup> who found no difference in neuropsychological function in MTBI participants with premorbid depressive antecedents compared to those with none. However, Cicerone and Kalmar<sup>6</sup> only included emotional antecedents; for this reason, only partial comparison is possible with the present study, which included neurological and educational antecedents, as well as psychological (emotional) ones.

The fact that antecedents hardly affect performance in complex attention tests is an argument in favour of the neurological origin of MTBI symptoms. The study by Paré *et al.*<sup>29</sup> supports the fact that MTBI participants would present objective attention deficits. Evans<sup>11</sup> links the slower processing of information with the presence of DAD, because of the slower neural transmission. A number of studies recognize the presence of DAD in MTBI participants. Moreover, the advent of

more advanced brain imaging techniques enables the viewing of white matter lesions following MTBI. There is also enough neuropathological and neuroradiological evidence to show that the frontotemporal regions sometimes suffer focal damage in MTBI.<sup>21</sup> These types of lesions affect attention, concentration and memory function, and executive functions. Attention deficits thus may originate from the injury.

## Acknowledgments

The authors wish to thank Caroline Bouchard and Fernand Bouchard of the Centre hospitalier régional de Trois-Rivières for their valuable collaboration on this research project.

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## PART II

# Intervention

### 1. Intervention based on the multifactorial nature of mild traumatic brain injury

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Wormser Honoré, Nicole Brière, Michelle McKerral*

### 2. Psychological intervention after mild traumatic brain injury: The use of resilience as a conceptual framework

*Frédéric Banville, Laurence Majaron*





# Intervention based on the multifactorial nature of mild traumatic brain injury

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**SUMMARY** – A considerable portion (15%) of individuals who sustain a mild traumatic brain injury (MTBI) develop chronic post-concussion syndrome (CPCS) leading to long-term limitations in various aspects of their lifestyle, including work. These patients do not always receive the appropriate services. One reason for this is the lack of clear clinical and scientific frameworks and convergent studies on the subject. Theoretical and clinical frameworks for

rehabilitation need to be further evaluated and developed for intervention with this clientele. This article presents a critical analysis of the recent literature on prognostic factors for CPCS and return to work that highlights the multifactorial nature of MTBI. Analysis of the results of these studies, together with the theoretical concept of MTBI developed by Kay *et al.*<sup>18,19</sup> as well as our clinical experience over the last 5 years with an MTBI clientele, has allowed us to develop specific clinical programming for the portion of this clientele that require services. We also present the interdisciplinary intervention model based on the prognosis for recovery that we apply, which remains to be evaluated.

**KEYWORDS** – mild traumatic brain injury, chronic post-concussion syndrome, prognostic factors, intervention

### Introduction

In industrialized countries, traumatic brain injury (TBI) is a major public health problem, due to its high incidence (200/100,000), the fact that most people affected are aged 15 to 30,<sup>27,30,13</sup> and the resulting possibility of long-term disability. The main causes are road accidents (~40-50% including cycling and pedestrian accidents), falls (~25%), violence (~20%), and sports, recreational activities and others (~5-10% all categories combined).<sup>27,13</sup>

Some 85% of all TBIs are mild (MTBI).<sup>1</sup> About 15% of these are at risk of developing chronic symptoms resulting in long-term limitations affecting many aspects of daily life, including work.<sup>23,19</sup> The impact of these symptoms on the individual's overall functioning is not well understood, and people who have sustained a TBI and whose symptoms persist for more than 3 months do not receive all the appropriate services. A lack of clear clinical and scientific frameworks and convergent studies on the subject is one reason for this. Empirical studies of this topic do not reflect the Quebec clinical context, and the existing clinical programs would benefit from being based on more solid scientific information.

This article examines the issues surrounding MTBI and presents a critical review of the literature on diagnostic, prognostic, and treatment factors for MTBI. The findings are then discussed in relation to the specialized clinical programming for diagnosing and intervening with MTBI patients that has been used for 5 years in the TBI program at the Centre de réadaptation Lucie-Bruneau (CRLB). Finally, future directions for MTBI research are discussed.

### MTBI and CPCS

Road accidents, occupational accidents, falls, or assault may all involve impact to the head and cause brain injury. The mechanism for brain injury may be direct (blow to the head, head striking an object) or indirect (the brain is subjected to acceleration then deceleration when the head is projected forward then back). In most cases (85%),<sup>1</sup> brain injuries are mild and not always easy to identify. They

may or may not affect consciousness, and neuroradiological tests are often of no help with diagnosis.

Generally speaking, if the loss of consciousness or alteration in mental state lasts less than 30 minutes, and the person's ability to respond to various stimuli is hardly affected (severity assessed on the Glasgow Coma Scale, score usually between 13 and 15/15), MTBI is diagnosed.<sup>25</sup> People who have sustained an MTBI usually experience physical, cognitive or emotional post-concussion symptoms (PCS) (see Table 1) shortly after the accident, but these PCS generally dissipate within 3 months.<sup>19,17,20</sup>

TABLE 1

**Post-concussion symptoms**

Physical	Cognitive	Emotional
<ul style="list-style-type: none"> <li>• Headaches</li> <li>• Fatigability</li> <li>• Sleep disturbances</li> <li>• Dizziness, nausea</li> <li>• Vision problems</li> <li>• Hypersensitivity to noise and light</li> </ul>	<ul style="list-style-type: none"> <li>• Attention and memory problems</li> <li>• Organization and planning problems</li> <li>• Slowed information processing</li> </ul>	<ul style="list-style-type: none"> <li>• Irritability</li> <li>• Symptoms of anxiety</li> <li>• Symptoms of depression</li> <li>• Emotional lability</li> </ul>

However, a percentage (15%) of patients continue to present with these symptoms for longer; this is described as chronic post-concussion syndrome (CPCS).<sup>23,19,2,22</sup> CPCS alone is not sufficient to indicate an MTBI: the symptoms are not specific to CPCS, and may also be associated with pain, depression, or post-traumatic stress or found in the general population. Nevertheless, they may lead to functional impairment and disability in various areas.<sup>34</sup>

**Prognostic factors**

As the review of literature on MTBI confirms, this is a complex, multi-factorial problem that is poorly understood. Research into prognostic factors, which predict the level of recovery for an individual who has sustained an MTBI, is rare. Moreover, few of these studies have investigated the multifactorial nature of CPCS. Prognostic factors are usually analyzed individually, and measurement of the expected results (e.g. number of subjective complaints, results of neuropsychological tests, return to work, etc.) varies from one study to another.

Studies investigating what factors explain persistent symptoms and a deterioration in the person's overall function following an MTBI have mainly examined this issue in relation to return to work. It has now been shown that neurological damage alone does not explain the person's dysfunction. Interaction of physiological/neurological, psychological, or environmental factors present before, during, or after the accident (pre, peri or post accident) is now believed to lead to complications following the MTBI.<sup>19,18</sup>

*Indicators of CPCS and return to work*

Many studies appear to show that the occurrence of CPCS does not necessarily mean problems with returning to work (see Table 2). Women develop CPCS more often than men,<sup>34</sup> but are not less likely to return to work.<sup>15,37</sup> Moreover, pre-accident neurological problems may predispose certain people to CPCS,<sup>15</sup> without necessarily leading to problems with going back to work.<sup>34</sup> And the presence or absence of previous psychiatric problems does not necessarily affect the person's return to work.<sup>15</sup> Many studies suggest that secondary gains have a negative impact on recovery prognosis.<sup>3,5</sup> However, this correlation is not invariably found; some authors suggest it depends on the sample studied (e.g. legal proceedings to have injuries recognized and treated vs. attempt to obtain financial compensation).<sup>15,34</sup>

TABLE 2  
**Prognostic factors**

	CPCS	Return to work
<b>Indicators</b>	<ul style="list-style-type: none"> <li>• Female<sup>34</sup></li> <li>• Previous MTBI<sup>15</sup></li> <li>• Injury mechanism (direct or indirect)<sup>15</sup></li> <li>• Cause of accident (road accident vs. assault)<sup>15</sup></li> <li>• Number and severity of subjective complaints<sup>21,40</sup></li> <li>• Comorbid injuries (e.g. lumbar/cervical pain)<sup>10</sup></li> <li>• Intense emotional reactions peri and post accident<sup>21</sup></li> <li>• Psychological problems pre accident<sup>34</sup></li> <li>• Medicolegal proceedings<sup>3,5</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Latitude to make decisions at work<sup>37</sup></li> <li>• Injury mechanism (direct or indirect)<sup>15</sup></li> <li>• Cause of accident (assault vs. road accident)<sup>15</sup></li> <li>• Number and severity of subjective complaints (even many months post accident)<sup>9</sup></li> <li>• Depressive symptoms many months post accident<sup>15</sup></li> <li>• Results on certain cognitive tests (especially mnemonic)<sup>15</sup></li> <li>• Medicolegal proceedings<sup>3,5</sup></li> </ul>
<b>Non-indicators</b>	<ul style="list-style-type: none"> <li>• Age<sup>8,38,37,12,34</sup></li> <li>• Education<sup>8,38,37,12,34</sup></li> <li>• Neurological diagnostic criteria<sup>15,37,12,34</sup></li> <li>• Medicolegal proceedings<sup>15,34</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Age<sup>8,38,37,12,34</sup></li> <li>• Education<sup>8,38,37,12,34</sup></li> <li>• Gender<sup>15,37</sup></li> <li>• MTBI pre accident<sup>34</sup></li> <li>• Psychiatric problems pre accident<sup>15</sup></li> <li>• Medicolegal proceedings<sup>15,34</sup></li> </ul>

Age and education are also not clear indicators of CPCS or return to work.<sup>8,38,37,12,34</sup> However, age may be a moderating variable for return to work. Older people may have more trouble re-entering the workforce in general.<sup>38,15</sup> However, this relationship may be reversed under certain job-related conditions. For example, Drake *et al.*<sup>12</sup> report a more favourable prognosis for return to work in military ranks for older individuals (possibly because of their higher rank). Generally speaking, having some freedom to make decisions at work seems to be conducive to going back to work after an MTBI.<sup>37</sup>

A significant correlation has been revealed between the number and severity of subjective complaints (even months after the trauma) and return to work.<sup>8</sup> The development or presence of depressive symptoms months after the accident may also accentuate problems associated with going back to work.<sup>15</sup> More specifically, Ruffolo *et al.*<sup>37</sup> report that individuals who 6 to 9 months after the accident have maintained a certain level of social interaction have a better chance of returning to work. Some authors also suggest that the injury mechanism (e.g. object falling on head), cause of the accident (assault vs. road accident), and scores on certain neuropsychological tests (especially mnesic) are significant factors for predicting return to work.<sup>15</sup> The research has identified prognostic factors that affect or do not affect evolution towards CPCS or return to work. However, because most studies investigated and analyzed these factors separately, it was not shown which of them interacted more and most affected the prognosis of return to work.

### Approaches and intervention philosophy

Only a small body of literature assesses the efficacy of a specific intervention for people who have sustained an MTBI. However, a few publications suggest more or less standardized approaches for intervening with this population.<sup>14,28,21</sup> There are two different types of studies: those discussing a generalized intervention for all individuals who have sustained an MTBI, and those dealing only with treatment of people with CPCS.

#### *Generalized intervention*

In the first group of studies, the findings of the last 20 years clearly demonstrate that a short intervention in the days or weeks following the accident can significantly reduce the occurrence and severity of PCS in the MTBI population.<sup>26,29,39</sup> This type of intervention also seems to promote earlier return to work.<sup>36</sup> A sample of 165 neuropsychologists treating this population regarded the most important components of the intervention as education (82%), support and reassurance (74%), and promoting the gradual resumption of activities (56%).<sup>28</sup>

Few studies have attempted to measure the validity of these intervention approaches directly and empirically. Paniak *et al.*<sup>32</sup> recruited 111 adults who had sustained an MTBI and been admitted to hospital. The first sub-group received a rapid intervention, including reassurance that their problems were “real”, education about the nature of MTBI, and various general suggestions (gradual resumption of activities). The second sub-group underwent a more intense intervention, including neuropsychological/psychological assessment, follow-up to discuss the results, and additional treatment based on the needs identified. Approximately three months after the initial intervention, the results suggested more generalized improvements in terms of the number of spontaneous complaints, general health, and return to work. On the other hand, there was no significant difference between

the two interventions as regards number and severity of symptoms, time required for re-entering the community, number of medical treatments, or satisfaction with treatment. This study shows that reassurance has a positive impact on recovery and return to work for most people with an MTBI. However, it must be emphasized that among this study's exclusion criteria were factors that have been suggested as predicting CPCS (e.g. previous history of neurological or psychological problems<sup>15,34</sup>); this may explain why only a small percentage of the sample eventually developed CPCS and did not go back to work.

#### *Intervention specific to CPCS*

For some individuals, reassurance is not enough. On the contrary, anxiety and intolerance of symptoms may increase in the first few months, causing symptoms to persist and CPCS to develop.<sup>34</sup> However, studies specifically evaluating the intervention with persons with CPCS are not always well controlled. For example, two studies measuring the efficacy of interventions with MTBI subjects who had developed CPCS had no control group.<sup>8,16</sup>

The general consensus thus seems to be that a very brief, targeted intervention is an effective model for most patients, but an early, structured intervention is desirable for the minority.<sup>29,32</sup> Yet for this minority that develops CPCS but actually accounts for the majority of the clientele using services, there are no reliable studies presenting a specific intervention model to prevent the occurrence or persistence of CPCS.

#### *Clinical analysis of prognostics factors*

There is a model explaining the complexity of MTBI that reflects the interaction between the physiological/neurological, psychological, or environmental factors.<sup>19,18</sup> At the outset, the MTBI causes neurological, physical or cognitive problems that affect the person's level of functioning. This reduced functional level may itself lead to psychological reactions that exacerbate the cognitive and physical problems and thereby further reduce the functional level. This feedback loop fuels or worsens physical, cognitive and emotional symptoms in people who have sustained an MTBI.

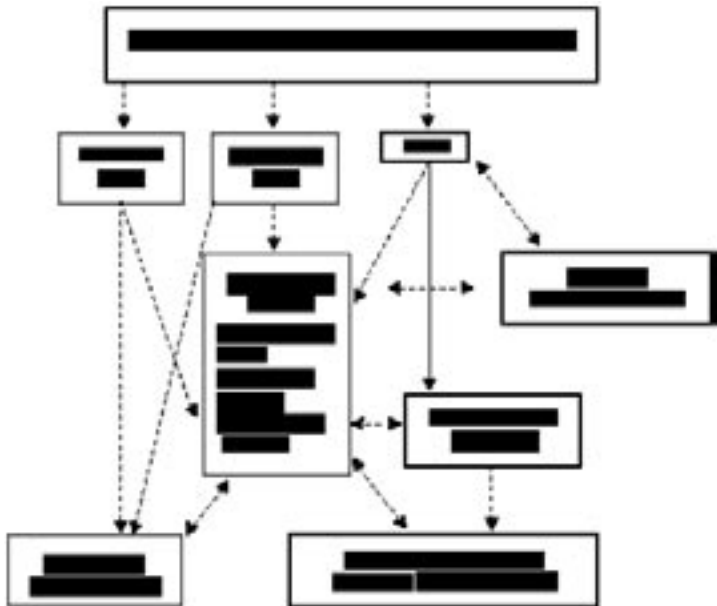
Lacroix and Kay<sup>4</sup> used this model for a training session grid listing the three types of prognostic factors for three periods in the life of the accident victim: pre, peri, and post accident. Analyzing prognostic factors in this manner would facilitate clinical work by predicting the evolution of symptoms; clinicians could then target the people who need services in order to break the feedback loop maintaining or aggravating PCS.<sup>19,18</sup> The efficacy of this model has not been tested in a systematic study. However, an approach of this type, combined with the findings of the intervention studies we analyzed and our experience with the MTBI clientele in the last five years, has enabled us to develop specific clinical programming for the portion of this clientele requiring services.

## Specific clinical programming for the MTBI clientele

In the last few years, adults who have sustained an MTBI and require intervention have increasingly been referred to institutions offering services for this clientele so that they can benefit from interventions appropriate to their condition (e.g. early intervention, rehabilitation). Most of the clients referred have been involved in road accidents (car, bicycle, pedestrian), occupational accidents, or falls, and they present clear symptomatology causing varying degrees of difficulty with daily life. Although these clients are increasingly being referred early on (in the first three months), some are referred later. To respond to the complex and particular needs of this clientele (see Figure 1), five years ago, we trained a team consisting of clinicians and a clinician-researcher working on the TBI program at the Centre de réadaptation Lucie-Bruneau (CRLB) and began a clinical and scientific undertaking. Reviewing the literature on prognostic factors was part of this process, and it enabled us to determine and fine-tune the approach and intervention philosophy used in the TBI program (mild injury component). The CRLB is a rehabilitation institution for a varied adult clientele (18 and over) with physical deficits that specializes in socio-professional and community integration; it serves the eastern end of the island of Montreal.

FIGURE 1

### Profile of the referred clientele



The program uses a screening procedure and intervention approach reflecting different individual and environmental factors that may affect the recovery prognosis and the person's resumption of daily activities. Early interdisciplinary interventions with a preventive focus are conducted by members of a small, specialized team (medicine, psychology/neuropsychology, social work, occupational therapy or physiotherapy). Identifying the various prognostic factors and their respective importance helps to identify people whose condition is likely to become chronic (symptoms persisting beyond three months). This allows for more accurate targeting of necessary and adequate interventions based on the recovery prognosis.

#### *Intervention based on recovery prognosis*

If the recovery prognosis is favourable, the intervention should ideally be brief, informative and educational; symptoms are assigned to their respective causes (e.g. reactionary anxiety, pain related to physical injury vs. MTBI or mixed) and clients are reassured about neurological recovery from the MTBI. Where the recovery prognosis is less favourable (complicated MTBI), it is more important to educate clients about the effect of interacting physical, psychological and environmental factors on functional recovery in order to prevent inactivity. In this context, strategies for coping with energy, emotions, and pain may be taught. In addition, depending on the initial psychological reactions, some people are offered support to help them adapt to temporary limitations. People with physical injuries are given treatment. Whatever the outlook, it is important to educate the families in order to support the clients and promote community adjustment. Another essential step is rapid determination of a framework for returning to work. Where CPCS is already present (usually more than three months after the accident), gradual resumption of cognitive and physical tasks is made a priority by teaching strategies for managing resources and symptoms as well as compensatory mechanisms and by building up tolerance to changes. To this end, a special approach has been developed for these clients, who have sustained what is known as a complicated MTBI.

#### *Intervention for clients with complicated MTBI*

Interventions with people who have sustained a complicated MTBI are designed to empower the individuals and foster the resumption of their previous way of life. The interventions take place in an ecological setting, with the help of an interdisciplinary team, and focus on individual needs. These interventions usually differ from interventions with patients who have sustained a moderate to severe TBI; they are not as frequent or intensive and do not usually deal directly with cognitive function.

**EMPOWERMENT.** The recommended approach is systemic and targets empowerment<sup>11</sup> through education, support, accountability and self-management of



resources. Clients' perception of changes in their lifestyle and their treatment priorities are documented. For this, we use, among others, a specific tool called PIC<sup>7</sup> (client intervention priorities), developed by clinicians on our program. This helps clients develop the goals they want to achieve over a specific period (6 to 8 weeks between each interdisciplinary intervention plan). Setting measurable goals enables the clients and the clinicians to assess their progress. Family members are encouraged to take part in the intervention plan, to help them adjust and allay their distress.<sup>33</sup> Other ways of optimizing empowerment include letting clients manage their own schedule and handle their own personal and socio-professional matters.

**INTERDISCIPLINARY TEAMWORK.** A physician, psychologist, social worker, occupational therapist, physiotherapist and physical educator are all available, but do not necessarily intervene in every case or at the same time. When at least two people treat one individual, frequent communication is important to ensure cohesion between team members and consistent interventions. It is important that all team members convey the same message (e.g. as regards the recovery prognosis) in order to reassure the person. The therapists should always be ready to adjust to the changes inherent to a client-centred approach. In addition, therapists collaborate on their intervention in order to achieve a common goal. For example, the social worker and the psychologist may help the person handle various family stress factors undermining recovery. The social worker works with the person to identify practical strategies for resolving conflicts with a relative, and the psychologist helps the person manage the feelings triggered by these conflicts; it is then easier for the person to use the strategies taught by the social worker.

**CLIENT-CENTRED APPROACH.** Focusing on clients' needs does not mean responding to all their requirements, but taking their needs and limitations into account. Interventions should be necessary, sufficient, and respectful of individual pace. For example, it is important to minimize interventions and use as few clinicians as possible when dealing with individuals who have dependent personality traits and trouble taking responsibility. Clinicians may also become involved gradually or stop intervening as the treatment progresses. For example, severely depressed people will sometimes see only the psychologist and the physician until they are able or willing to accept services from other clinicians. At some stages, only one clinician still deals with such a client (e.g. occupational therapist, when the person returns to work).

The work of the client-centred interdisciplinary team allows interventions to target a predominant problem that particularly affects daily living. This problem is a factor or common denominator on which clinicians act simultaneously, to respond to the objectives identified by the client. For example, post-concussion fatigability is a common symptom that may affect overall lifestyle. An initial goal envisaged by

clients may be preparing five meals a week. To help them do so once again, the occupational therapist teaches principles of energy management and fosters their integration. The physician offers appropriate pharmacological treatment. There are also various ways in which people can boost physical endurance (e.g. fitness program, exercising at home, etc.). Finally, for anxious or depressed clients, psychological support will help reduce their reaction to symptoms. Achieving this specific objective will also benefit other aspects of life that have been disrupted.

**ECOLOGICAL APPROACH.** Interventions encouraging the gradual resumption of daily life are conducted in the clients' own settings. In this way, they experience actual triumphs and rebuild their confidence as they regain control over their environment. A framework for the return to work should be devised as soon as possible by providing support for employers and individuals who have sustained a MTBI in the workplace. Until they go back to work, it is important that they maintain the links that keep their job available and stay in touch with colleagues. The family is an integral part of the process and receives information and support, which fosters the adjustment of the environment.

### Research perspectives

In light of the existing literature and its positive impacts, the clinical approach that we and others recommend for MTBI patients requiring intervention is increasingly supported by solid scientific studies. The recent systematic review of the literature on MTBI conducted by the World Health Organization Collaborating Centre Task Force on Mild Traumatic Brain Injury<sup>5,6</sup> highlighted major findings: 1) there are few studies on intervention following an MTBI; 2) there is a lack of longitudinal studies using a reasonable size sample with appropriate control groups, and 3) it is important to consider all possible etiological factors and their interactions before making causal inferences.<sup>24</sup>

We have embarked upon a retrospective study of the prognostic factors for return to work in a sample of MTBI patients presenting CPCS who have completed rehabilitation in a Quebec clinical setting. It is our intention to analyze the links between a set of neurological/physiological, psychological, and environmental factors and the return to work of the sample, in light of Kay's multifactorial and interactional model.<sup>18</sup> This project is based on an analysis of medical charts from the rehabilitation phase. The idea is to identify the main factors involved in returning to work. A prospective study will then be conducted, systematically evaluating these factors in an MTBI clientele from the beginning of rehabilitation and measuring the efficacy of interventions.

The multifactorial nature of MTBI can only be fully understood by considering factors related to the person, such as resilience.<sup>8</sup> With a more thorough knowledge of the elements fostering resilience, traumatic brain injury patients could be helped

to develop positive behaviour whereby they understand and promote their health.<sup>31,35</sup>

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# Psychological intervention after mild traumatic brain injury: The use of resilience as a conceptual framework

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**SUMMARY** – Psychological intervention after a mild traumatic brain injury (MTBI) is a complex and debated issue when adaptive disorder is present. There are currently few intervention models for the treatment of MTBI patients sustaining major psychological distress. This article proposes an original clinical model for psychological intervention using resilience as the conceptual framework. It is based on a critical review of scientific literature on MTBI and resilience. The concepts of locus of control, hardiness, and attribution of meaning were used for constructing this model and integrated in the intervention from an ecosystemic perspective. The model promotes the use of personal strengths for maximized adjustment and the resumption of development. Clinical experience shows that this intervention model offers a pertinent and useful framework for understanding psychological adaptation after MTBI. Finally, empirical validation should be done briefly to understand the main concepts empirically related to resilience.

**KEYWORDS** – Mild traumatic brain injury, psychological intervention, adjustment disorder, rehabilitation, resilience

## Introduction

The problems associated with mild traumatic brain injury (MTBI) are substantially different from those that follow a moderate or severe traumatic brain injury. Because objective damage to the brain is considered minor or absent in an MTBI, purely neurological hypotheses do not easily explain the cognitive, physical, or affective deterioration observed in approximately 15% of these patients. Such a problem can be tackled at two points in time, early on or later in the evolution of the condition. Considering the interacting problems (neurological, psychological, premorbid, post-injury, social, and family problems), treating this population requires specialized competencies and knowledge. Since the introduction of the MTBI screening protocol by the Société de l'assurance automobile du Québec (SAAQ), a number of clini-

cians have developed extensive and diversified clinical expertise. Unfortunately, however, there are very few reliable or valid scientific studies on the effectiveness of interventions in rehabilitation centers with the MTBI population.<sup>8</sup>

The model presented here is based on the clinical reflections of several members of a multidisciplinary committee on MTBI within the neurotraumatology team at the Centre de réadaptation en déficience physique (CRDP) Le Bouclier. The model has not been tested by studies, but it is based on scientific literature and the clinical experience of the committee members. The psychological intervention provided during rehabilitation was reviewed using 2 specific practices: conventional cognitive intervention after MTBI and a “resilience intervention” after psychological trauma.

Although the original intention was to construct an interdisciplinary intervention with people who had sustained an MTBI,<sup>5</sup> this article deliberately deals only with the psychological aspects of intervention with this clientele. Elaborating on each of the model’s interdisciplinary and systemic components was too lengthy for a single article. The first part of the text describes the primary problems characterizing MTBI and defines the main concepts empirically related to resilience. The second part presents the clinical intervention model, which was constructed after a critical review of the literature. The last part discusses the model’s methodological and clinical strengths and weaknesses.

### **MTBI: Diagnosis and expected evolution**

MTBI affects approximately 80% of the people who have sustained a traumatic brain injury (TBI).<sup>13</sup> Medical diagnosis is based on precise criteria, which must be promptly identified by the emergency physician to confirm the presence of an MTBI. Without the information about the person’s condition at the time of the accident, it is impossible to make a definite diagnosis. Briefly, the criteria are as follows: loss of consciousness (less than 30 minutes); Glasgow Coma Scale score (between 13 and 15/15, 30 minutes after impact); neurology and neuroradiology examinations (CT-Scan and MRI) that are usually negative (but may also be positive); and duration of post-injury amnesia (less than 60 minutes). Many studies have shown that the Glasgow Coma Scale score and the duration of post-injury amnesia are the most reliable prognostic factors.<sup>11</sup> Once the MTBI has been diagnosed, a screening process begins. The multidisciplinary team looks for “convincing” signs, post-concussion symptoms, and premorbid and current stress factors in order to predict how the person’s condition is likely to evolve.

The subject’s post-injury condition may evolve in one of 3 clinical patterns: asymptomatic phase, early phase, or chronic and symptomatic phase (later phase). People who are asymptomatic should be discharged from the emergency room without further intervention because they are unlikely to develop a post-injury problem. During the 3 to 6 months after the accident, subjects may move on to an



early phase in which they generally present a post-concussion syndrome (PCS). This is defined by a set of symptoms that may be physical (e.g. sleep problems, nausea, headaches, vomiting), cognitive (e.g. attention or mnemonic complaints), or emotional (e.g. irritability, moodiness, impatience).<sup>26</sup> The concept of PCS is a matter of debate in the medical community because it is not a clinical entity specific to MTBI. It can also be found in other psychiatric pathologies such as anxiety or depressive disorders.<sup>27</sup> However, it is 2.7 times more common in MTBI patients than in the psychiatric population.<sup>33</sup>

Studies show that if treated promptly (reassurance, information, as well as the other means of conveying knowledge), 85 to 95% of MTBI patients with PCS make a full recovery during the first year after the accident.<sup>2</sup> Brain damage after MTBI is acknowledged to be neurochemical and usually resolves itself during the first 3 to 6 months without leaving objective sequelae. However, symptoms sometimes persist or worsen after 6 months; subjects then enter a chronic phase in which symptoms can no longer be attributed to the blow to the head. The actualization of various psychological and social risk factors has instead been identified as probably contributing to the chronicization of PCS. Many negative prognostic factors are generally identified during the psychological assessment by analyzing certain components of the premorbid personality, family and social stress factors during the year leading up to the accident and psychological and medical histories.

The psychological intervention with MTBI outpatients who are in a chronic and symptomatic phase takes place when the person presents a chronic PCS (CPCS) 6 months after the accident. Given the long delays before the intervention begins, the person waiting for treatment can develop adjustment problems that may be accompanied by depression or an anxiety disorder. The DSM-IV<sup>3</sup> defines adjustment disorder as emotional and behavioural symptoms that develop in response to one or more identifiable stressful events 3 months after their onset. These symptoms lead to significant distress and functional impairment in the individual's educational, professional, or social sphere. These specific adaptive problems are usually explained by the nature of the person's reaction to the accident (e.g. catastrophic reaction, post-traumatic stress disorder). This initial reaction is often influenced by the characteristics of the accident (e.g. force of the impact, material damage, rollover, etc.). The intervention with a chronic MTBI patient is challenged by a crystallization of the symptoms, amplification, and/or a distorted attribution by the patient of the etiology of the symptoms. It is also complicated by personality disorders or other factors observed in this population (e.g. psychiatric history, medical history, psychosocial stressors, economic difficulties, etc.). Traditionally, neurophysiologists have favoured an intervention that focuses on cognitive or behavioural reconstruction or a brief cognitive rehabilitation. However, recovery of these individuals is resistant to traditional intervention, leading the SAAQ and the Ministère de la santé du Québec (MSSS) to modify the service offer to this population.

This ministerial reorientation has adopted the conclusion of the International Task Force on MTBI, which is aware that the scientific literature is incomplete. In spite of a reorientation of MTBI patients with chronic psychological and/or physical problems, clinical rehabilitation experts have demonstrated that the concept of resilience provides a useful framework to enhance the comprehension of such problems, allowing such patients to receive brief and effective treatment taking into account their individual strengths.

The development of resilience skills has often been observed in children who have sustained severe psychological trauma. Many authors have remarked that without the love, support, and security provided by their environment, the traumatized child could not “bounce back”, or in other words, adjust to the ordeal and continue to develop positively.<sup>14,30</sup> Resilience is a complex, abstract concept with no universally acknowledged definition among the clinical and scientific community. It is usually viewed as a dynamic process leading to the pursuit of positive development in the face of adversity, which may take the form of stress, illness, or trauma.<sup>39</sup>

Dyer and McGuiness<sup>17</sup> analyzed the concept of resilience in order to understand inter-individual reactions in a “crisis” situation. They found that some people react symptomatically to what is objectively a minor event, while others experience no distress when faced with a trauma that is objectively significant. Resilience thus appears to be a natural process resulting from a successful (or unsuccessful) operation within the person’s adjustment systems. Weakening of these systems before or after the trauma may increase the risk of developing adjustment problems, particularly if the situation endures, as it does when MTBI is accompanied by significant and chronic psychological distress.<sup>31</sup>

The concept of resilience is based on the principle that people must be exposed to a certain number of risk factors and conditions regarded as adverse in order to develop their competency for appropriate adjustment.<sup>37</sup> This adaptability depends on the capacity of individuals to utilize a certain number of protective factors that counterbalance the effect of the risk factors and hence pursue their development. Dyer and McGuiness<sup>17</sup> defined protective factors as a necessary component of resilience and therefore of positive adjustment. To use and develop these protective factors, people must possess certain individual, interpersonal, and familial competencies.<sup>17</sup> A review of the scientific literature revealed hundreds of protective factors that facilitate personal and family adjustment. These factors may be divided into 3 main categories: cognitive, emotional, and relational.<sup>6</sup> Utilizing these protective factors enables the feeling of personal control to be actualized during the adverse situation.<sup>12</sup>

Chorpita and Barlow<sup>12</sup> reported that the early experience of loss of control in life events creates a learning situation also called “operant conditioning”, during which the child expects to undergo negative repercussions from day-to-day life. This belief increases the state of anxiety that modulates the individual’s perception

of events, causing events to be interpreted as more serious than they are. These attributions of meaning usually occur in a context of newness and reflect the presence of psychological vulnerability. Because developmental considerations of this kind affect the way the person reacts to the accident, it is important to describe the subject's premorbid history in order to better understand the reaction.

The two factors most often linked statistically to resilience are locus of control and hardiness. Locus of control is the extent to which people feel they have control over events in their environment.<sup>12</sup> More precisely, in a study by Robin et al.,<sup>21</sup> resilience is seen as the capacity to have the right degree of control. Resilient children do better in school. They have fewer concentration problems, move more rapidly towards a so-called internal locus of control, develop better comprehension of friendship, and have better social relations. The concept of hardiness was introduced by Kobasa<sup>24</sup> in order to compare different responses to daily stressors. For him, locus of control is enclosed in the concept of hardiness. Individuals demonstrate hardiness when they are able to experience a high degree of stress in their daily lives without manifesting any psychosomatic disorder. Individuals who display hardiness have 3 main personal traits: they believe in their ability to control and influence events in their lives (i.e. internal locus of control), they are deeply committed to (or involved in) their daily activities, and they perceive change as exciting, challenging, or a chance to grow and learn. For Callahan,<sup>10</sup> hardiness is a personal trait that enables individuals to resist life's stressors. Therefore, when control is possible in a given situation, environmental challenges and psychological stress potentially associated with these challenges may facilitate adaptive functioning over time.

Resilience may be viewed as a personal, social, or cultural trait leading to positive adjustment in a difficult life context.<sup>37</sup> Thus resilience is not just a set of individual characteristics or personality traits. As it is not acquired for life,<sup>14,15,32,35</sup> the protective factors individuals may develop at a particular time do not make them "invulnerable" to subsequent ordeals. Indeed, for Larose,<sup>29</sup> people become resilient to something, in a specific context. It is therefore logical to assume that transference of resilience competencies from one situation to another does not always occur. Paradoxically, it appears that having overcome significant challenges in the past acts as a protective element. Moreover, when individuals credit themselves with successful adjustment, they remember their "control capacity" over an adverse situation. As a result, emotional stability at a specific point in their lives may have a major impact on their capacity to use and express their "acquired adaptive competencies". In some cases, accumulation of adverse situations may strengthen individuals; in other cases it makes them more vulnerable. According to Chorpita and Barlow,<sup>12</sup> certain people may benefit from a steeling effect: some stressors may enable a certain individual "immunity" to be actualized. In other words, the ordeal may be a learning experience as a result of which these individuals develop new adjustment reflexes in adverse situations.

A small portion of the MTBI population may present with major psychological distress not easily accounted for by the severity of the neurological impairment. Few scientific studies of intervention have been conducted with this population. In view of the current administrative and clinical debate surrounding the services offered to people who have sustained an MTBI, the trend is to believe that needs of a psychological nature are no better explained by the traumatic event and that the psychological problems could be the consequences of premorbid fragilities. On the other hand, some clinicians and researchers take the view that the traumatic event acts as a trigger of a latent or pre-existing psychological problem.<sup>1,4,6,11,20,26,28,34</sup> Clinicians working with individuals who have sustained an MTBI deal with the need to deliver prompt high-calibre and specialized rehabilitation care for this clientele; paradoxically, there are no valid and scientifically based intervention models. Aiming to address this challenge, this article proposes an intervention model using resilience as a conceptual framework.

### **An alternative model of psychological intervention**

The intervention model presented here was developed for and by clinicians to address precise clinical needs in the absence of an existing model validated by scientific research. It was developed after a review of the scientific literature on MTBI and resilience. Eight hundred articles on MTBI and 300 articles dealing with resilience were reviewed and discussed over a 2-year period (2002 to 2004) during which 2 forum discussions attended by experts on resilience were held, one during the CRDP Le Bouclier scientific presentations and the other during a discussion day held by the Centre de recherche sur l'intervention éducative (CRIE) of Sherbrooke University. Clinical interventions were also used to explain and validate the model.

The model is based on resilience as a conceptual framework. Its construction is based on the impact, recognized in the literature analyzed, of protective factors, locus of control, hardiness, and attributions of meaning in the person's positive adaptation. It is also based on a rehabilitation philosophy focused not on repairing a premorbid condition, but on learning new ways of living after injury. The intervention inspired by resilience focuses on the residual capacities and personal resources of the individuals rather than on their deficits and impairments. Because it is inspired by the concept of resilience, this intervention model also uses an ecosystemic approach, which looks at individuals in their surroundings (family-environment) and takes into account their dynamic and the complexity of their interactions as well as the interdependence between themselves and their social and physical environment. This framework of analysis provides a fuller understanding of the subjects' psychological distress by viewing it from an ecological, historical and systemic perspective. The originality of this model lies in its capacity to recognize and develop individual and family strengths. Experiences are no

longer seen as sources of error, but opportunities for learning; the events are normalized and adaptation is fostered. Finally, unlike conventional approaches that normalize the suffering by emphasizing objective data from assessment, the model described here allows people to use their own subjectivity to create an, individual sense of control and normality.

FIGURE 1  
Basis for a psychological rehabilitation intervention after MTBI

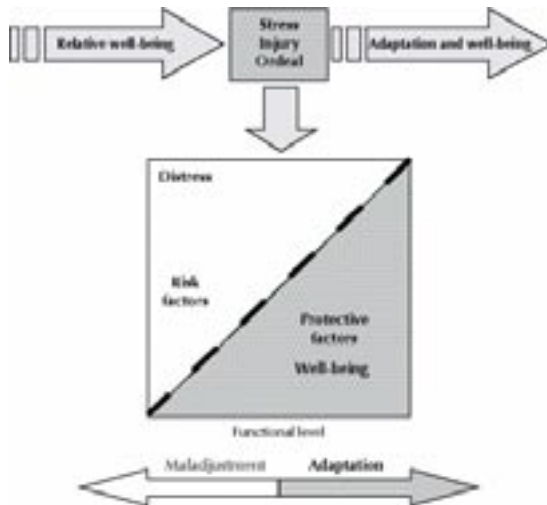


Figure 1 shows the resilience based intervention model. It assumes that prior to the MTBI (or a stressor or an ordeal), each subject was relatively well adjusted. It also assumes that in 5 to 15% of cases, MTBI patients will move gradually along a continuum from comparative well-being to potentially major psychological distress. In these cases, people may progress from an adjusted state to a maladjusted state. The aim of the intervention is to use and actualize protective factors in order to promote and support the coping skills of the individuals in the face of psychological distress. Consequently, it minimizes risk factors for psychological deterioration and helps MTBI individuals to carry on with their lives.

Generally, subjects who present a chronic and symptomatic profile after an MTBI arrive at the rehabilitation center with symptoms of anxiety, depression or adjustment problems. These problems are perceived or experienced as difficult to overcome. As presented in Figure 1, the MTBI (including the circumstances surrounding the accident, minor neurological damage, and meaning attributed to perceived changes) causes an emotional imbalance in the subjects. This in turn generates psychological distress that may be more or less intense or disabling. In most of the clinical cases encountered, this distress triggered adjustment problems that caused functional difficulties with the resumption of normal activities, par-

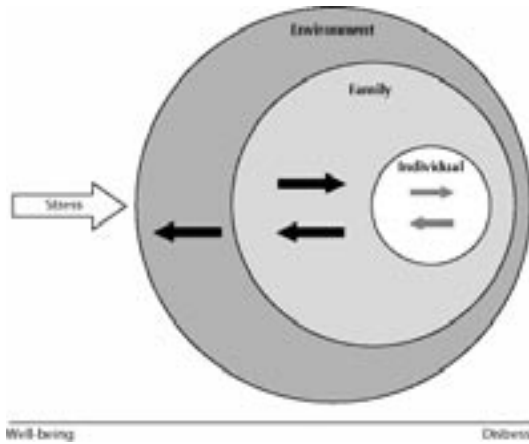
ticularly work, school, and social roles. The psychological distress may be fuelled by various individual or social risk factors.

*Psychological distress*

The main element to be considered in constructing the intervention is the intensity of the subjects’ psychological distress. Questionnaires and semi-structured clinical interviews can be used to qualify and quantify the degree of psychological distress. It is also important to understand how the psychological distress impacts the family and social environment. From an ecosystemic perspective, it is recognized that the imbalances experienced by people experiencing psychological distress may also cause the immediate family a form of psychological suffering.<sup>22,40</sup> As shown in Figure 2, life stressors in MTBI patients with chronic and symptomatic profiles may generate adjustment problems that vary in severity. When they enter a chronic and symptomatic phase (6 months after the trauma), they may manifest difficulty in coping with their own psychological pain. This condition affects the family at different points in the process. Family members may share the discouragement, or they may be impatient with the trouble the subjects have “pulling themselves together”.

FIGURE 2

**Impact of stress factors on the psychological well-being of the person and the family**



Studies on resilience have shown that the level of psychological distress may be affected by different psychological factors. Locus of control, hardiness and attribution of meaning are some of the factors that most influence adaptation.<sup>15,16,19</sup> An analysis of these factors must take into account the history of the subjects’ development. Understanding their coping patterns when faced with an adverse situation enables people who have sustained an MTBI to cope with their psychological distress and regain hope that “something can be done”.

*Attribution of meaning*

Subjective evaluation of the individual trauma is important because it represents a favorable or unfavorable prognostic factor with respect to the use of adjustment mechanisms. Self-evaluation of the severity, combined with the search for meaning, allows the scope of the situation to be gauged through the MTBI patients' eyes and shows how they see themselves in relation to the ordeal (victim or actor). The traumatic event (automobile accident, fall) may be perceived as an assault or a narrow escape from death; this perception of the event triggers anxiety and major adjustment problems. These clinical syndromes lead to temporary cognitive and emotional problems (e.g. attention and memory problems, irritability, feeling of being on the verge of tears, sleep problems) that are often diagnosed as PCS. The symptoms cause significant psychological distress because individuals feel a loss of control over their bodies and their lives. Lack of knowledge about the problem may lead people with an MTBI to misinterpret the etiology of the symptoms; they may then "dramatize" the situation, thereby raising the level of anxiety (psychological distress) and aggravating their symptoms.<sup>7</sup> By safeguarding their resilience, the clinician supports them, guiding them to modify their representation of the injury. The challenge facing the injured is to make the injury tolerable in order to relegate it to the realm of memory and then to reconstruct themselves in order to resume their normal development. This process requires a form of "psychological resistance" allowing individuals to tolerate emotional and physical distress for a certain period, while they modulate their affects in a socially acceptable manner.<sup>12</sup> This self-reconstruction must take into account the individuals' ecosystems and personal histories.

*Psychotherapy and use of clinical intervention model*

The adjustment process has two key components: understanding and action. Understanding refers to the awareness and introspection required of MTBI individuals so that they can grasp the factors that fuel their psychological distress. By engaging in this reflection process within a psychotherapeutic relationship, subjects are better able to assign (or restore) a meaning to what has happened to them. Action refers to learning and trying out new ways of proceeding that are a necessary part of change.<sup>18</sup>

*Intervening with respect to cognitive protective factors*

After sustaining MTBI, individuals feel the need to obtain information about their condition in order to understand what is happening to them. Sharing information helps them to de-dramatize the event and leads to more realistic perceptions about damage/deficits. In order to promote their psychological healing, individuals then must develop adaptive skills by testing various problem-solving strategies. According to clinical observations, this makes it easier for them to acquire a sense of control and competencies.

*Intervening with respect to emotional protective factors*

At this stage, the principal objective is to cultivate self-confidence and self-esteem. Depending on the personality type, we can gain access to intellectual rigour, the desire to form a relationship, the ability to become detached from certain emotions, creativity, etc. The poles of independence-dependency should also be exploited. By building up their independence and autonomy, individuals learn to feel competent about adjusting their affects and expressing their emotions. Staying close to and relying upon their support network, individuals remain optimistic about their own appeal (an acquired sentiment allowing the person to feel supported and remain hopeful about “being rescued”).<sup>16</sup>

*Intervening with respect to relational protective factors*

Social skills and use of the resources available in the environment are essential. The human resources accessible to individuals refer to the “resilience mentor” proposed by Cyrulnik,<sup>14</sup> among others. Resilience mentors enable people to feel supported and assisted in their psychological distress. The individuals should be allowed to express their needs and fears without feeling weak or humiliated. Considering other people’s ideas and being open-minded are protective factors that allow people to redefine and modify their perceptions and self-image. Finally, moving on to action and resuming social roles is necessary in order to actualize the gains achieved during treatment.

**Critique of the intervention model**

Rehabilitation of individuals who have sustained MTBI is currently a matter of worldwide debate. A number of researchers have reported that post-traumatic psychological symptoms are not related to the TBI itself. This has re-opened the debate about the usefulness of offering specialized rehabilitation services.<sup>8</sup> From an administrative standpoint, given the relatively small percentage of people with a psychological problem (5% to 15% depending on the studies), decision-makers are examining whether it is “cost-effective” to invest so many resources in so few people who could be treated in mental health clinics rather than rehabilitation centers.<sup>8,13</sup> However, we should consider and acknowledge that the event is responsible for the deterioration in the individuals’ psychological condition, insofar as it is the decompensation factor in a stable premorbid subclinical condition.<sup>20</sup> The rehabilitation intervention is justified and necessary where premorbid and post-injury neurological and psychological factors explain a profile whose severity often surprises family and clinicians alike; these individuals’ reactions are disproportionate compared to the severity of the TBI, and this in turn triggers permanent psychological changes that require new skills to be learned.<sup>2</sup>

The work of the International Task Force on MTBI has shown that there are few scientific studies rigorous enough to justify the generalizing of interventions



to the entire population concerned. The small number of studies deemed to be valid and the fact that Quebec is poorly represented in them force clinicians and decision-makers to remain critical of intervention models proposed in rehabilitation. Nevertheless, urgent clinical needs make it essential to test a treatment model that ensures the validity and reliability of rehabilitation interventions.

The clinical intervention model presented in this article is inspired by the work of Jourdan-Ionescu.<sup>23</sup> In her study, she found that promoting the use of protective factors specific to the individuals and their family circles and environments can facilitate the development of resilience. Helping them develop or strengthen these factors includes guiding them in identifying resilience mentors in their environments who can act as points of reference, building up their self-esteem and encouraging them to try out “new successes” and “personal triumphs”.

The scientific literature acknowledges that the changes achieved during therapy depend on many individual factors. Patients have been found to use a variety of coping methods, but no one method stands as making a significant difference in terms of adaptation.<sup>38</sup> However, Callahan<sup>10</sup> feels that rehabilitation psychology interventions should enable the individuals to develop behavioural skills that allow them to adapt to stressors, break the pattern of self-defeating thoughts, and acquire a sense of self-efficacy. For Masten,<sup>31</sup> an intervention that respects the principles of resilience should promote individual competencies as elements protecting against stress. It should also take into account all the individual and environmental adaptation resources. Finally, the author feels it is important to focus on the abilities and adjustment systems leading to healthy development.

The main goal of the intervention model proposed in this article is to develop protective factors in people who have sustained an MTBI, in order to reduce psychological distress and thereby promote individual and family adaptation. There are various reasons why this clinical intervention model is of value. It is inspired by an ecosystemic approach and allows the individuals and their families to benefit from an intervention adjusted to their reality that reduces their psychological distress. Currently, this approach is not used with the MTBI population. In addition, this model lets people adapt to adverse situations by learning new skills and starting from a familiar reference point: themselves. The main weakness of the model is that it has not yet been empirically tested and validated. The scientific process should therefore be pursued further by subjecting the clinical intervention model to rigorous scientific study.

From a clinical standpoint, many people presenting a chronic profile have received rehabilitation services based on this model from the authors of this article. One example is E.D., a young woman in her thirties, seen in rehabilitation nearly 3 years after her MTBI. She came to the rehabilitation centre suffering from severe depression caused by the consequences of her accident (death during the accident, end of romantic relationship, loss of her home, etc.). Neuropsychological testing also revealed moderate cognitive disturbances such as memory problems,

while the neuroradiology examinations showed no objective evidence of brain lesions. Psychological treatment took place over a 12-month period and focused mainly on the subject's perception of being treated as dishonest by her insurer although she had suffered so much loss. E.D. thus saw herself as a victim and maintained her depressive affects, since she was unable to "regain" her self-esteem in relation to society (attribution of meaning). By using E.D.'s introspective capacities as well as her capacity for reasoning and analysis (protective factors), and fully understanding how important she felt it was to be honest (perception), the intervention shed light on the factors perpetuating the depression. The analysis also put into perspective the loss and injuries E.D. suffered as well as her values, obliging her to redefine herself. E.D. was thus able to work through certain grieving processes and gradually succeeded in going on with her life (recovering control and self-worth). Today, even though E.D. is not working, she is no longer suffering from depression. She also says she is comfortable with her new life choices.

The model is supported by the positive clinical results obtained with psychotherapy and the positive changes that people report in their daily lives. However, we must be careful when judging the efficacy of a treatment on the basis of clinical intuition. The resilience based intervention model requires an empirical validation. There are 2 main challenges at this stage. First is the issue of resilience: is it a concept or a construct? According to Larose,<sup>29</sup> if resilience is seen as a concept, it refers to a set of stable characteristics or traits that define a person. Thus, individuals who are resilient accordingly possess the resources needed for resilience, and those who are not, do not. As a construct, resilience is a theoretical model in which various concepts interact. In this case, individuals do not know they are resilient, but become so after being exposed to adverse situations.<sup>37</sup> Acquiring scientific knowledge of the factors that influence adaptation defined as resilience would be an initial step. The next challenge would be to define and measure the individual and social factors that make up personal, family, and social resilience. Inter-individual variability and the existence of a multitude of protective factors required methodological and statistical limitations, because of the number of subjects needed to validate the relevance of the many factors involved.

Most of the scientific literature describes resilience in individuals who have not received treatment. The role of clinicians in the complex process of resilience needs to be addressed. The transference elements and the therapeutic relationship seem to be more important than the approach used. Therapists (through their personality, style and knowledge) can be decisive in the changes brought about in their patient. Moreover, attachments (in childhood and adulthood), cognitive style, and patient personality type are essential pointers for shaping the intervention. So even in the absence of a scientifically validated model, psychological interventions may nevertheless facilitate the use of resilience resources.

## Conclusion

Authors and researchers have trouble explaining the difference between adaptation and resilience. But all agree that resilience adds “something more”. Resilience differs from adaptation in that it specifically denotes the resumption of development. In psychological terms, people develop resilience competencies at the point when the psychological distress has significantly diminished. In daily life, an improvement in psychological condition should translate into the gradual resumption of family, social and professional roles.

Treating people who have sustained an MTBI and present with severe psychological distress is a challenge but also a necessity. The challenge lies in offering an effective intervention when the prognosis for recovery is negative and there is a high risk of persisting psychological distress. Treatment is a necessity because most MTBI patients who have adaptation problems do not succeed in resuming their professional and social activities to a satisfactory degree, and their failure to do so leads to high social costs. These individuals also endure severe psychological distress affecting every aspect of their lives, not least the quality of their family and interpersonal relationships.

Although resilience falls short of fulfilling rigorous research criteria, the notion does offer clinical advantages, one of which is focusing particular attention on the strengths of individuals (and their families). The notion of resilience gives people hope and ways of surmounting the psychological distress at a particularly hard time in their lives. In addition, resilience forces therapists to practice “preventive and positive” psychology that helps patients explore and focus on their strengths and abilities through ecological action, which renders the intervention more concrete.

The clinical intervention model presented in this article has not been empirically validated. For the moment, it is impossible to say whether this model genuinely helps people to actualize their resilience resources or adapt more effectively. However, this clinical reflection is necessary. By using this model as a conceptual framework, psychologists and multidisciplinary teams can concentrate on a “positive” intervention that is compatible with data from the field of health psychology. With resilience as a conceptual framework, we are able to design a preventive intervention and forestall the deterioration of the psychological condition of these MTBI patients over the long term by tapping into individual and social strengths. This will promote the empowerment of the individuals and their environment.

## Acknowledgments

We wish to thank the interdisciplinary committee that made this article possible. Our thanks go to Luc Forest, M. A., Neuropsychologist, Ginette M. Morin, B. Sc., Social Worker, Catherine Roteux, MOA, Speech-Language Pathologist, Anne-Marie

Brault, B.Sc., Occupational Therapist, Claire Johnson, M.Ps., Neurophysiologist, and Annie Lahaie, Ph.D., Neurophysiologist. Finally, we thank Véronique Laniel, MOA, Speech-Language Pathologist, for reading the English version of this article.

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## Acknowledgments

We extend sincere thanks to the scores of individuals, researchers, clinicians and students who generously and unreservedly submitted their ideas or research to the CRIR Publications Committee. Without their commitment, this second volume of CRIR publications, on traumatic brain injury, would never have appeared.

Warm thanks are also due to the Orientation and Research Committee, particularly Eva Kehayia and Robert Forget, Scientific Directors of CRIR, for their confidence, moral support and funding.

Needless to say, we are indebted to the members of the Publications and Editing Committees for their unfailing intellectual rigour, dynamism and team spirit throughout this stimulating project. We also thank Paule Samson for the cover design.

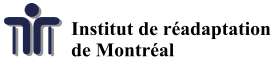
Last but not least, we wish to express special thanks to Manon Denischuck, Coordinator of the Publications Committee, and Francine Desmarais, CRIR Administrative Coordinator. Their organization, efficiency, enthusiasm and good humour were invaluable.

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## List of Abbreviations

AA	Alcoholics Anonymous
BOTMP	Bruininks-Osteretsky Test of Motor Proficiency
BPPV	Benign paroxysmal positional vertigo
CEP	Cognitive evoked potential
CPLT	Comité permanent de la lutte contre la toxicomanie
CR	Cognitive rehabilitation
CRIE	Centre de recherche sur l'intervention éducative
CRIR	Centre for Interdisciplinary Research in Rehabilitation
CRLB	Centre de réadaptation Lucie-Bruneau
CT Scan	Axial tomography
CVA	Cerebral vascular accident
CVLT	California Verbal Learning Test
DAD	Diffuse axonal damage
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition
EP	Evoked potential
FMRI	Functional magnetic resonance imaging
GIRAFE	Groupe inter-réseaux de recherche sur l'adaptation de la famille et de son environnement
IFR	Intensive Functional Rehabilitation
ISCEV	International Society for Clinical Electrophysiology of Vision
MMPI	Minnesota Multiphasic Personality Inventory
MRI	Magnetic resonance imaging
MTBI	Mild traumatic brain injury
NA	Narcotics Anonymous
PCS	Post-concussion symptoms
PCS	Post-concussive syndrome
PET	Positron emission tomography
PP	Psychoanalytic psychotherapy
PQRS	Perception of Quality of Rehabilitation Services - Montreal
PSA	Psychoactive substance abuse
PST	Postural Stress Test
REPAR	Réseau provincial de recherche en adaptation-réadaptation
SAAQ	Société de l'assurance automobile du Québec
TBI	Traumatic brain injury
TRIAGE	Technique for Research on Information by Animation of a Group of Experts
VEP	Visual evoked potential

