UNIVERSITÉ DU QUÉBEC

ESSAI DE 3E CYCLE PRÉSENTÉ À
L'UNIVERSITÉ DU QUÉBEC À TROIS-RIVIÈRES

COMME EXIGENCE PARTIELLE
DU DOCTORAT EN PSYCHOLOGIE
(PROFIL INTERVENTION)

PAR
RENÉ VILLEMURE

SYMPTÔMES AUTORAPPORTÉS APRÈS UN TRAUMATISME CRANIOCÉRÉBRAL LÉGER : COMPARAISON DE DEUX MÉTHODES D'ÉVALUATION

MAI 2011

UNIVERSITÉ DU QUÉBEC À TROIS-RIVIÈRES

DOCTORAT EN PSYCHOLOGIE PROFIL CLINIQUE (D.PS.)

PROGRAMME OFFERT PAR L'UNIVERSITÉ DU QUÉBEC À TROIS-RIVIÈRES

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Ce document est rédigé sous la forme d'un article scientifique, tel que stipulé dans les règlements des études de cycles supérieurs (Article 138) de l'Université du Québec à Trois-Rivières. L'article a été rédigé selon les normes de publication d'une revue reconnue et approuvée par le Comité d'études de cycles supérieurs en psychologie. Les noms du directeur et du co-directeur de recherche apparaissent donc comme co-auteurs de l'article publié.

Sommaire

Le traumatisme craniocérébral léger (TCCL) peut provoquer divers symptômes physiques, cognitifs et psychologiques plus ou moins durables et incommodants. Parmi les principaux symptômes rencontrés figurent les maux de tête, la fatigue, les étourdissements, les difficultés de concentration ou de mémoire, le ralentissement de la pensée, les changements de l'humeur, l'anxiété et l'irritabilité. Règle générale, ces symptômes se résorbent dans les premières semaines ou les premiers mois suivant le fait accidentel, mais peuvent persister et entraîner des répercussions fonctionnelles. De multiples facteurs essentiellement neurologiques, personnels et environnementaux sont susceptibles d'influencer l'apparition et le maintien des symptômes. L'évaluation des symptômes s'effectue couramment à l'aide de questionnaires de type *checklist*. Un nombre variable de symptômes parmi les plus souvent signalés est suggéré afin de vérifier leur présence et d'estimer leur gravité. Une telle procédure repose fortement sur la perception du répondant à l'égard de sa condition. La subjectivité entourant les symptômes soulève toutefois une question importante : leur présentation par les questionnaires de type *checklist* pourrait-elle influencer la manière de les rapporter et conduire à leur surévaluation? La présente étude, parue dans la revue *Brain Injury*, compare deux méthodes d'évaluation des symptômes autorapportés en phase initiale post-TCCL. L'échantillon était composé de 354 participants adultes recrutés sur une période de 36 mois dans cinq centres hospitaliers du Québec. Tous les participants ont été contactés par téléphone durant la première (5-10 jours), la quatrième (23-33 jours) et la douzième (85-95 jours) semaine suivant leur traumatisme. À chacune des trois

entrevues, il leur a été demandé d'identifier leurs symptômes librement (méthode spontanée) et, subséquemment, à partir d'un questionnaire standardisé de type *checklist* (méthode suggérée). Les résultats issus d'une analyse à mesures répétées ont révélé la présence d'un effet d'interaction significatif entre la méthode d'évaluation et le temps de mesure. Pour chacun des trois temps de mesure, le total de symptômes obtenu selon la méthode suggérée était significativement plus élevé que celui obtenu selon la méthode spontanée. Pour chacune des deux méthodes d'évaluation, le total de symptômes diminuait significativement de la première à la quatrième semaine et de la quatrième à la douzième. Des analyses de fréquences ont également permis de constater que les types de symptômes variaient sensiblement d'une méthode d'évaluation à l'autre. En somme, la contribution majeure de cette étude a été de démontrer que l'utilisation d'un questionnaire de type *checklist* incitait clairement à rapporter en phase initiale un plus grand nombre de symptômes par rapport à leur identification libre, confirmant ainsi les données d'une recherche similaire de notre équipe (Nolin, Villemure, & Héroux, 2006) indiquant une telle influence chez des participants symptomatiques 12 à 36 mois post-TCCL. Il apparaît donc plausible que la présentation de symptômes à l'intérieur d'un questionnaire de type *checklist* puisse conduire à une surévaluation, bien qu'une telle approche puisse également contribuer à réaliser une évaluation plus exhaustive. À notre avis, l'intégration d'une mesure permettant une identification libre des symptômes, précédant l'administration habituelle du questionnaire de type *checklist*, s'avérerait utile afin de limiter une possible surévaluation et de favoriser une analyse clinique plus approfondie. Cliniciens et chercheurs sont invités à considérer cette recommandation en

plus de continuer à demeurer prudents dans l'interprétation des symptômes rapportés suite à un TCCL.

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Remerciements

Je remercie sincèrement mon directeur, monsieur Pierre Nolin, Ph.D., professeur titulaire en psychologie à l'UQTR, pour ses enseignements de qualité et son constant soutien. Votre présence, monsieur Nolin, m'a permis d'atteindre de grands objectifs et de donner le meilleur de moi-même. Je remercie également D[re] Natalie Le Sage, urgentologue et chercheure clinicienne au Centre hospitalier affilié universitaire de Québec pour sa disponibilité à codiriger cette recherche. Je remercie les évaluatrices de ce travail pour leurs commentaires positifs et utiles, mesdames Annie Stipanicic, Ph.D., professeure agrégée en psychologie à l'UQTR et Marie-Christine Ouellet, Ph.D., chercheure au Centre interdisciplinaire de recherche en réadaptation et intégration sociale et professeure associée en psychologie à l'Université Laval. Pour leur appui fort apprécié, je remercie monsieur Carl Lacharité, Ph.D., professeur titulaire en psychologie à l'UQTR et directeur du Centre d'études interdisciplinaires sur le développement de l'enfant et de la famille (CEIDEF), madame Micheline Langevin, secrétaire du CEIDEF, monsieur Michel Alain, Ph.D., professeur titulaire en psychologie à l'UQTR et madame Carol Kane, secrétaire aux programmes de cycles supérieurs en psychologie. Je remercie spécialement Aubert Martin et Scott Irving pour le temps consacré à la révision de ce travail. J'exprime ma profonde reconnaissance et mon admiration à mon père sans qui il m'aurait été impossible de parvenir à l'aboutissement de mes divers projets. Difficile de trouver les mots pour décrire à quel point ton engagement inconditionnel aura été déterminant dans ma réussite : quelle chance de pouvoir, à chaque jour, compter sur un père exceptionnel! Nombreux sont tes rôles : père, meilleur ami, mentor et tant

d'autres… Ainsi, tu peux partager pleinement la satisfaction qui m'habite. Enfin, je remercie les membres de ma famille, qui, de différentes manières, m'ont accompagné et encouragé dans les diverses sphères de ma vie.

Article

Self-Reported Symptoms During Post-Mild Traumatic Brain Injury in Acute Phase: Influence of Interviewing Method

SELF-REPORTED SYMPTOMS DURING POST-MILD TRAUMATIC BRAIN INJURY IN ACUTE PHASE: INFLUENCE OF INTERVIEWING METHOD

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Running head: Interviewing method and self-reported MTBI symptoms

Abstract

Primary objective: To compare two interviewing methods used in the evaluation of acute self-reported symptoms after a mild traumatic brain injury (MTBI).

Method and procedures: A cohort of 354 MTBI-adult participants was recruited over a period of 36 months in emergency rooms of five Canadian trauma hospitals. The participants' symptoms were evaluated by means of telephone interviews conducted at three measurement intervals: approximately 1, 4, and 12 weeks following their MTBI. In each interview, the participant reported their symptoms both spontaneously ('free-report method') and by answering a checklist-type questionnaire ('checklist method').

Results: A significant interaction effect was found between interviewing method and measurement interval. Total reported symptoms were significantly greater for the checklist method than for the free-report method at each measurement interval. Total reported symptoms decreased significantly between weeks 1 and 4 and between weeks 4 and 12 for both interviewing methods. In addition, the symptom types differed between the interviewing methods.

Conclusion: The interviewing method used influences both the total and the type of self-reported symptoms during the acute phase of recovery post-MTBI.

Keywords: Mild traumatic brain injury; self-reported symptoms; free-report interview; checklist questionnaire.

Introduction

Mild traumatic brain injury (MTBI) is a common public healthcare problem (Borg et al., 2004; Cassidy et al., 2004; National Center for Injury Prevention and Control, 2003). The annual worldwide incidence rate, calculated from hospital statistics, varies between 100 and 300 cases per 100,000 people. However, the true proportion may be up to two times higher given the large number of people who do not consult an emergency room (ER) doctor after trauma (Cassidy et al., 2004; e.g. 503.1 per 100,000 people in the United States according to Bazarian et al., 2005). Cases of MTBI in the adult population account for between 70% and 90% of all traumatic brain injuries (American Congress of Rehabilitation Medicine, 1993; Bazarian et al., 2005; Cassidy et al., 2004). Men, especially young adults between the ages of 15 and 24, have a markedly higher risk of having an MTBI than women (Cassidy et al., 2004; Langlois et al., 2003). Children (Keenan & Bratton, 2006) and seniors (Thompson, McCormick, & Kagan, 2006) can also be affected. The main causes of MTBI are motor-vehicle collisions, falls, and sports or recreational activities (Bazarian et al., 2005; Cassidy et al., 2004; Kraus & Chu, 2005).

Although there is currently no consensus on the definition of MTBI, the WHO Collaborating Centre for Neurotrauma Task Force on Mild Traumatic Brain Injury (Task Force; Carroll, Cassidy, Holm, Kraus, & Coronado, 2004a) has established the following definition: an MTBI is an acute brain injury resulting from mechanical energy to the head from external physical forces. Operational criteria for clinical diagnosis include one or more of the following: (*a*) confusion or disorientation, (*b*) loss of consciousness

for 30 minutes or less, (*c*) post-traumatic amnesia for less than 24 hours, and/or (*d*) other transient neurological abnormalities such as focal signs, seizure, and intracranial lesion not requiring surgery. A score of 13–15 on the Glasgow Coma Scale after 30 minutes post-trauma or later upon presentation for health care is also mandatory. These manifestations must not arise from alcohol, drugs, or medications; from other injuries or their treatment (e.g. systemic injuries, facial injuries, or intubation); from other problems (e.g. psychological trauma, linguistic barrier, or coexisting medical conditions); or from penetrating craniocerebral injury. Compared to moderate and severe traumatic brain injuries, MTBI is often more difficult to diagnose because of the rapidity with which certain acute signs (i.e. the diagnostic criteria) heal and because of the rarity with which abnormal structures are detected through neuroimaging (Ruff et al., 2009).

Self-reported symptoms after an MTBI are common and vary from case to case. Post-MTBI symptoms are commonly described according to three distinct categories (i.e. physical, cognitive, and psychological/emotional categories) and based on two phases of recovery (i.e. the acute phase, which can last up to 3 months, and the persistent phase, which generally varies between 3 and 12 months but has been known to last even longer) (Carroll et al., 2004b). Certain symptoms are more common, including headaches, fatigue, dizziness, insomnia, poor concentration, memory problems, slower processing speed, depressed mood, anxiety, and/or irritability (Alves, Colohan, O'Leary, Rimel, & John, 1986; Bohnen, Twijnstra, & Jolles, 1992; Carroll et al., 2004b; King, 1997; Lannsjö, G eijerstam, Johansson, Bring, & Borg, 2009; Lundin, de Boussard, Edman, & Borg, 2006). Note that these symptoms are not exclusive to MTBI; they are

often encountered in individuals with other conditions (e.g. chronic pain, depressive disorders) and even in those without diagnosis (Fox, Lees-Haley, Ernest, & Dolezal-Wood, 1995; Gasquoine, 2000; Gouvier, Uddo-Crane, & Brown, 1988; Iverson 2006; Iverson & Lange, 2003; Iverson & McCracken, 1997; Smith-Seemiller, Fow, Kant, & Franzen, 2003; Trahan, Ross, & Trahan, 2001). Generally, the physical and cognitive symptoms occur most often during the acute phase and quickly fade away, whereas the psychological symptoms tend to appear later on (Carroll et al., 2004b). The duration of these self-reported symptoms allows us to estimate how long post-MTBI recovery will take (McCrea, 2008). Normally, rapid symptom recovery is expected independently of the severity of the diagnostic criteria that characterize the initial trauma (Carroll et al., 2004b; Iverson, Lovell, & Smith, 2000; Iverson, Zasler, & Lange, 2007; McCrea, Kelly, Randolph, Cisler, & Berger, 2002). Indeed, it is well-established that the symptoms spontaneously and fully disappear in the overwhelming majority of cases (perhaps over 90%) during the first few weeks, or at the very most the first few months, following the MTBI (Carroll et al., 2004b; McCrea, 2008; McCrea et al., 2009; Iverson, 2005). However, a non-negligible proportion (approximately 5% to 10%) have an atypical recovery profile and complain of persistent symptoms beyond the 3 to 12 months of expected recovery time. Of this group, certain individuals present symptoms that impede their return to a normal life, including working at their jobs (Boake et al., 2005; Bohnen et al., 1994; Paniak, Toller-Lobe, Melnyk, & Nagy, 2000; Ruffolo, Friedland, Dawson, Colantonio, & Lindsay, 1999). Various factors other than those defining the initial neurological manifestations are likely to cause the symptoms to persist beyond the

typical recovery period of several days to a few weeks post-MTBI (Carroll et al., 2004b; Iverson, 2005; McCrea, 2008).

Currently, it is still difficult accurately to disentangle the many factors that cause the appearance and persistence of post-MTBI symptoms. There are two schools of thought in this long-standing debate (Bohnen & Jolles, 1992; Carroll et al., 2004b; Lishman, 1988; McCrea, 2008; Ruff, 2005). The first hypothesis stressed the importance of neurological factors resulting from the cerebral injury. These are the so-called physiogenic factors, including transitory pathophysiological changes in the cerebral cellular self-regulation mechanisms (neurometabolic cascade) and injury to the integrity of the cerebral parenchyma in the form of traumatic axonal lesions or focal damage (Bigler, 2008; Gaetz, 2004; Gennarelli & Graham, 1998; Giza & Hovda, 2001; Iverson, 2005; McAllister, Sparling, Flashman, & Saykin, 2001; Ommaya, Goldsmith, & Thibault, 2002). The second hypothesis emphasized pre-morbid, co-morbid, and post-morbid factors surrounding the trauma. These are the so-called psychogenic factors, such as socio-demographic aspects (Bazarian et al., 1999; Evans, 1992; Ponsford et al., 2000), exposure to stress (Bryant & Harvey, 1999; Gouvier, Cubic, Jones, Brantely, & Cutlip, 1992; Moore, Terryberry-Spohr, & Hope, 2006), psychological and social antecedents (Evered, Ruff, Baldo, & Isomura, 2003; Fenton, McClelland, Montgomery, MacFlynn, & Rutherford, 1993; Ruff, Camenzuli, & Mueller, 1996), and pursuit of financial compensation (Binder & Rohling, 1996; Paniak et al., 2002; Reynolds, Paniak, Toller-Lobe, & Nagy, 2003). For the time being, the most recent data tend to converge toward a hybrid hypothesis in which acute cerebral dysfunction is the chief cause of a set

of initial MTBI symptoms while personal and environmental pre-, peri-, and post-injury variables are the chief cause of long-term symptoms and failure to return to pre-injury levels of functioning (see, for review, Carroll et al., 2004b; Iverson, 2005; King, 1997; King, 2003; McCrea, 2008; Mittenberg & Strauman, 2000; Ruff, 2005; Ryan & Warden, 2003; Wood, 2004). Thus, polarized physiogenic or psychogenic perspectives are currently less prevalent in the literature, perhaps because they seem one-sided or incomplete. The extent to which prognostic risk factors influence MTBI s ymptoms remains to be seen, which underscores the importance of conducting future studies in order to make sense of the current data (Carroll et al., 2004b).

Whatever the case, part of what makes the analysis of these contributing factors such a complex undertaking is that the symptoms reported after an MTBI are based on self-perception; individuals assess their own condition following the injury. Indeed, the checklist-method questionnaires designed to evaluate MTBI symptoms generally present a set of typical symptoms whose presence and severity are then estimated by the respondent. This type of questionnaire has the distinct advantage of providing a simple, quick, and general overview of symptoms during the initial screening or during follow-up. However, since this analysis is self-reported, the result is based solely on the respondent's subjective claims about their post-MTBI condition and the related symptoms. Given the possibility of response biases in symptom self-evaluation (Carroll et al., 2004b; Mittenberg, Patton, Canyock, & Condit, 2002; Wong, Regennitter, & Barrios, 1994), conservative interpretations of the clinical data are advisable. In the same vein, certain studies on this effect have suggested that perception of symptoms can be

influenced considerably by the patient's expected MTBI damage (Ferguson, Mittenberg, Barone, & Schneider, 1999; Gunstad & Suhr, 2001; Hahn, 1997; Mittenberg, DiGiulio, Perrin, & Bass, 1992). The 'good old days' bias, for example, refers to the tendency to idealize one's pre-injury condition, underestimate one's previous health problems, and falsely attribute one's symptoms to the MTBI because of worry over its potential consequences (Gunstad & Suhr, 2001). It is therefore necessary to determine if the fact of listing symptoms in a checklist-type questionnaire affects the answers given by respondents.

Preliminary findings have come out of our research with participants who were still reporting symptoms 12 to 36 months following their MTBI (Nolin, Villemure, & Héroux, 2006). Overall, participants seem to report significantly more symptoms when using an interview-based checklist as compared to a free-report interview, where they identified their symptoms without being prompted. However, it should be noted that these participants' recovery profile was atypical: they still had symptoms more than 12 months post-MTBI. Consequently, some of them could have had complicating factors that in turn could have interfered with their symptoms. For this reason, the present study is again focused on the question of free-report interview versus interview-based checklist, but this time using a sample of participants whose symptoms were evaluated at 1 week, 4 weeks, and 12 weeks post-MTBI. Thus, the majority of them are expected to have a positive recovery and not present with risk factors that may hinder their recovery. This is the most representative sample of the MTBI population.

Objective and hypothesis

This study compares the two interviewing methods (free-report interview and interview-based checklist) in the evaluation of self-reported symptoms at three measurement intervals during the acute phase of recovery post-MTBI (1, 4, and 12 weeks). Our research hypothesis is threefold: (1) that total reported symptoms would be greater through the interview-based checklist than through the free-report interview, (2) that total reported symptoms would decrease over time for both interviewing methods, and (3) that the symptom types would differ between the two interviewing methods used.

Method

Participants

The sample (n = 354) was comprised of 248 men (70.1%) and 106 women (29.9%). Their ages ranged from 14–82 years, with the mean age being 37.25 years (SD = 18.13 years). As for education level, 193 had completed ≤ 12 years of study (54.5%) while 161 had completed > 12 years (45.5%). Among those with > 12 years, 103 (64%) had completed professional or college studies, and 58 (36%) had earned a university degree. The majority of participants were employed (58.8%); the others were studying (22.6%), unemployed (5.6%), or retired (13%).

The major causes of MTBI in this study were falls (31.9%), motor-vehicle collisions (24.3%), and sports or recreational activities (20.1%). Minor causes included bicycle accidents (7.9%), impacts to the head with a static or moving object (6.2%), off-

road vehicle accidents (4.2%), assaults/battery (2.8%), and vehicles hitting a pedestrian (2.5%). According to the Glasgow Coma Scale evaluations conducted in the ER, 284 had a score of 15 (80.2%), 66 had a score of 14 (18.6%), and 4 had a score of 13 (1.1%). The distribution of participants based on the MTBI diagnostic criteria defined by the Task Force (Carroll, Cassidy, Holm, Kraus, & Coronado, 2004a) is presented in greater detail in Table 1.

Insert Table 1 about here

Procedure

This study was conducted in cooperation with the Centre hospitalier affilié universitaire (CHA) de Québec (trauma and emergency medicine department) over a period of ~36 months (November 2005 to December 2008) in a network of five Canadian trauma hospitals: CHA de Québec, Hôtel-Dieu de Lévis, Hôpital Charles-LeMoyne de Longueuil, Centre Hospitalier Régional de Trois-Rivières, and Hôpital du Sacré-Cœur de Montréal. The participants were selected using specific inclusion and exclusion criteria. Specifically, participants were included in the sample if their MTBI (1) was documented in a medical file, (2) met the Task Force's definition (Carroll, Cassidy, Holm, Kraus, & Coronado, 2004a), (3) occurred 24 hours or less before the ER visit, and (4) did not require hospitalization. Individuals were excluded if they (1) were under the age of 14, (2) were unfit to participate for medical reasons, (3) refused to be

contacted at each follow-up interval, or (4) were enabled to understand either English or French.

Participants were recruited using a pre-established procedure in which they voluntarily accepted to be contacted as part of a telephone follow-up process in the first 3 months following their MTBI. As soon as an individual who met all the inclusion criteria came to the ER for an MTBI, they were invited to take part in the study; verbal consent was recorded in the file by the traumatology team in the ER at the hospital. Next, each consenting individual received a telephone call from the research coordinator at the CHA de Québec providing a detailed explanation of how the study would be carried out. Following this, the coordinator mailed all participants a consent form approved by the Research Ethics Committee in each hospital. Consent was obtained from a parent or guardian for individuals between 14 and 18 years of age.

Each participant received three telephone interviews approximately 10–15 minutes long. These were conducted at approximately 1 week (5–10 days), 4 weeks (23–33 days), and 12 weeks (85–95 days) after the MTBI in order to evaluate their symptoms. In each interview, two distinct interviewing methods were used, always in the same order: first the 'free-report' method (in which the participant freely reported their symptoms), then the 'checklist' method (in which the participant identified their symptoms from a checklist-type questionnaire of the most common post-MTBI symptoms). As per the agreements made with the different hospitals, the interviews were conducted either by the nurse associated with the traumatology program or by the research coordinator. Objective data, an integral part of the medical file, were also

collected systematically in the ER. Such data include diagnostic criteria, causes of injury, and other medical risk factors.

Measurement tools

Method 1: Free-report method

The first part of the telephone interview involved participants freely reporting symptoms, i.e. with no prompts or suggestions from the examiner. The examiner asked the following question: "I would like to first know whether you still have symptoms from your mild traumatic brain injury, and, if so, which ones?" No further questions were asked. The examiner took note of all symptoms mentioned by the participant. This method was followed at each of the three measurement intervals. For each participant, a total reported symptoms score was calculated according to the criterion of 'presence or absence of symptom since the MTBI' (1 point for each reported symptom).

For the purposes of comparison, all freely reported symptoms were later sorted into categories. These categories correspond to those used in the checklist method (see Method 2 below). Some symptoms were freely reported but did not appear in the checklist questionnaire. These symptoms were 'difficulty finding words' and 'difficulty evaluating distances' (cognitive); 'change in personality', 'anxiety or nervousness', 'emotional sensitivity', and 'loss of interest' (psychological); 'physical pain', 'balance problems', 'hearing problems', 'numbness', 'loss of appetite', 'diminishing sense of taste', 'muscle stiffness', 'black-spot vision', and 'cardiac palpitations' (physical).

Method 2: Checklist method

The second part of the telephone interview consisted of listing the symptoms that were presented to the participants, i.e. by the examiner going through a list of symptoms typically observed after an MTBI. The examiner, as specified by the Rivermead Post Concussion Symptoms Questionnaire (RPQ; King, Crawford, Wenden, Moss, & Wade, 1995), gave the participant the following instruction: "I am now going to read a list of symptoms. For each symptom, I would like you to tell me whether you currently have (within the past 24 hours) this symptom from your mild traumatic brain injury." The RPQ consists of a checklist of 16 commonly experienced MTBI symptoms (see questionnaire in appendix); the respondent estimated the severity of each using a scale of 0 (asymptomatic) to 4 (severe). It is a widely used and very reliable questionnaire with valid measurement properties for the MTBI symptoms (see, for specific details, King, Crawford, Wenden, Moss, & Wade, 1995). In accordance with the RPQ, the examiner took note of all symptoms named by the participant. This method was followed at each of the three measurement intervals. The symptoms in this study were analyzed strictly according to the criterion of 'presence or absence of symptom since the MTBI' (1 point for each reported symptom). Thus, the two interviewing methods were comparable.

Results

This section is divided into two parts. The first part compares the total reported symptoms for the free-report method with those for the checklist method at each of the three measurement intervals (i.e. at 1, 4, and 12 weeks). The second part compares the

symptom types reported for both interviewing methods at each of the three measurement intervals.

Total reported symptoms

Table 2 presents the participants' average total reported symptoms for both interviewing methods at each of the three measurement intervals. Analyses with repeated measures were carried out by crossing the interviewing method with the measurement interval. Therefore, this involved a 2 (interviewing method) x 3 (measurement interval) ANOVA with doubly repeated measures. Since the Mauchly sphericity test was significant and thus indicated that the variance and covariance were not symmetrical, the Greenhouse-Geisser correction was used to interpret the results. Significant main effects were found for interviewing method [F (1, 353) = 337.28, $p <$ 0.001] and measurement interval [F (1.75, 618.24) = 120.06, $p < 0.001$]. Thus, the total reported symptoms were significantly different between the two interviewing methods (irrespective of the measurement interval) and between the three measurement intervals (irrespective of the interviewing method). The interaction between interviewing method and measurement interval was significant [F (1.84, 650.07) = 61.28, $p < 0.001$], indicating differences in total reported symptoms between the two interviewing methods at each measurement interval and between the three measurement intervals for each interviewing method. Figure 1 illustrates this interaction clearly.

Firstly, analysis of simple effects of interviewing method at each of the three measurement intervals indicated that total reported symptoms at week 1 were significantly greater for the checklist method (M = 4.27) than for the free-report method

(M = 1.39) [F (1, 353) = 358.86, $p < 0.001$]. The same relationship was observed at week 4 ($M_{\text{checklist method}}$ = 2.98 and $M_{\text{free-report method}}$ = 0.85) [F (1, 353) = 217.21, $p < 0.001$] and at week 12 ($M_{\text{checklist method}}$ = 2.00 and $M_{\text{free-report method}}$ = 0.57) [F (1, 353) = 146.69, $p < 0.001$].

Secondly, analysis of simple effects of measurement interval for each of the two interviewing methods indicated that total reported symptoms at the three measurement intervals varied significantly for both the free-report method [F (2, 706) = 156.11, $p < 0.001$] and the checklist method [F (2, 706) = 239.17, $p < 0.001$]. *A posteriori* comparisons (using the Bonferroni correction) for the free-report method indicated that total reported symptoms dropped significantly ($p < 0.001$) from week 1 (M = 1.39) to week 4 (M = 0.85) and from week 4 to week 12 (M = 0.57). The same relationship was observed for the checklist method at each of the three measurement intervals ($M_{\text{week 1}}$ = 4.27, $M_{\text{week 4}}$ = 2.98, and $M_{\text{week 12}}$ = 2.00).

Analysis of total reported symptoms for each of the two interviewing methods at each of the three measurement intervals (see Table 2) also indicated that the participants reported 3.07 times more symptoms at week 1 in the checklist method (an average of 4.27 symptoms for the checklist method versus an average of 1.39 symptoms for the free-report method). The participants also reported 3.51 and 3.54 times more symptoms in the checklist method at weeks 4 and 12 respectively.

Insert Table 2 and Figure 1 about here

Symptom types

To examine further the differences between the free-report method and the checklist method, symptom types reported for each interviewing method at each measurement interval were compared. Table 3 presents the frequencies and percentages of symptoms reported by the participants for both interviewing methods and at each measurement interval. Three general observations surface from this comparison.

First of all, the cognitive, psychological, and physical symptom types that were reported in the free-report method differed slightly from those reported in the checklist method at the three measurement intervals. For example, eight physical symptoms were reported at week 1 in the free-report method, while none of these symptoms was reported in the checklist method (i.e. 'physical pain', 'balance problems', 'hearing problems', 'numbness', 'loss of appetite', 'muscle stiffness', 'black-spot vision', and 'cardiac palpitations'). Also at this same week, two physicals symptoms were reported in the checklist method, while none of these symptoms was reported in the free-report method (i.e. 'noise sensitivity' and 'light sensitivity'). Thus, participants reported a greater variety of symptoms in the free-report method.

Secondly, the cognitive, psychological, and physical symptom types that were common to the two interviewing methods were reported much more often for the checklist method at each of the three measurement intervals. For example, 'forgetfulness, poor memory' were reported by 6.78% of participants in the free-report method at week 12, whereas they were reported by 22.60% of participants in the

checklist method at this same week. Thus, participants reported symptoms with a greater frequency in the checklist method.

Thirdly, physical symptoms were the most commonly reported symptom types for both interviewing methods at all measurement intervals. Cognitive symptoms were reported less often and, psychological symptoms were rarer still. For example, the top three symptoms reported for the free-report method at week 4 were, in decreasing order, 'headaches', 'physical pain', and 'feeling of dizziness'. The corresponding symptoms for the checklist method were 'fatigue', 'sleep disturbance', and 'headaches'. Thus, for both the free-report method and the checklist method, physical symptoms tended to dominate the responses.

Insert Table 3 about here

Discussion

The aim of this study was to compare two interviewing methods at three measurement intervals for self-reported symptoms after an MTBI. Specifically, the first method, called the free-report method, required participants to freely identify their symptoms, while the second method, called the checklist method, involved presenting a checklist-type questionnaire of typical MTBI symptoms to which respondents answered yes or no. Both types of interview were conducted three times, i.e. at 1, 4, and 12 weeks during the acute phase of recovery post-MTBI.

With regard to the research hypothesis, we can conclude, firstly, that the interviewing method significantly influences the total reported symptoms; participants reported more symptoms in the checklist method than in the free-report method. Secondly, the total reported symptoms decreased significantly over time for both interviewing methods; participants reported fewer symptoms between weeks 1 and 4 and between weeks 4 and 12. Thirdly, the symptom types differed (qualitatively) between the interviewing methods; participants did not report exactly the same cognitive, psychological, and physical symptoms in each interviewing method. The results of this study support our threefold research hypothesis.

Regarding the overall symptomatology observed in both interviewing methods, the participants reported various symptoms that fall into three distinct categories: physical, cognitive, and psychological. The symptoms most often cited in the literature were also the most fr equently reported in this study: headaches, fatigue, dizziness , insomnia, poor concentration, memory problems, irritability, and frustration. Moreover, the number of reported symptoms declined over time as the participants recovered. Thus, our results are consistent with those found in several other studies (Alves, Colohan, O'Leary, Rimel, & John, 1986; Bohnen, Twijnstra, & Jolles, 1992; Carroll et al., 2004b; King, 1997; Lannsjö, Geijerstam, Johansson, Bring, & Borg, 2009; Lundin, de Boussard, Edman, & Borg, 2006). It should also be mentioned that the sociodemographic, accidental, and diagnostic data that characterize our sample are representative of the MTBI population in general.

The present study bears on a hot topic in the literature regarding potential explanations for post-MTBI symptomatology. Indeed, research conducted over the past 15 to 20 years has identified many pre-, peri-, and post-traumatic factors, primarily neurological and psychological, that can interact with the appearance and persistence of symptoms (see, for greater detail, McCrea, 2008). The psychological aspects are particularly important in understanding symptom self-evaluation and their clinical significance. The observed difference in how symptoms were reported between the two interviewing methods may well find its explanation in how participants personally perceive their symptoms after the MTBI.

The role of symptom expectations may help explain the results arising from this study. In general, an individual's expectations play a major role in processing ambiguous stimuli; they aid in the establishment of 'temporary perceptual sets' or even contribute to a perceptive bias (Kirsh, 1999). In the case of MTBI, the presence of novel and unfamiliar symptoms can engender feelings of uncertainty or anxiety that influence the individual's perception of the injury itself (i.e. the ambiguous stimulus). Thus, in the mind of certain individuals who sustained an MTBI, the injury may seem overly serious due to the 'pessimistic' nature of their expectations. Under the nocebo effect, as described by Hahn (1997), expectations of non-specific, negative consequences ensuing from any undesirable event would be caused by a high level of distress. The related 'good old days' bias, as described by Gunstad and Suhr (2001), implies that negative expectations following an MTBI would lead individuals to report more symptoms and to minimize, or even ignore, manifestations that may predate their injury. An individual

who sustained an MTBI may therefore overestimate or idealize their pre-accidental state in a vague way ('things were far better before') and have expectations about their recovery that are equally vague. Other work by Gunstad and Suhr (2002) indicated that individuals in the general population expected similar symptoms for hypothetical cases of MTBI, post-traumatic stress, and depression. This suggests not only that the symptoms attributed to MTBI are non-specific, but that they can be — and in fact are — conflated with those of unrelated conditions. In other words, individuals with MTBI expect a set of symptoms that is effectively indistinguishable from what they would have expected in other conditions. The results of the present study could be explained by this retrospective bias, which leads the individual to reconstruct a version of the past 'through rose-coloured lenses' in light of a difficult recovery post-MTBI. The influence of personal expectations about MTBI could be encountered in both interviewing methods but manifest itself differently, i.e. through a tendency to over-report the number of symptoms in the checklist method and through a tendency to misattribute the type of symptoms in the free-report method. Therefore, when presented with a checklist, participants may have reported symptoms that were not directly due to their MTBI, since 'recall' was inflated in this method. It is also probable that errors in interpreting symptoms may have occurred when participants were asked to freely report their symptoms, since some of these symptoms (e.g. 'physical pain', 'numbness', 'muscle stiffness', 'loss of appetite') tend to be noticeably different from the typical post-MTBI symptoms. Symptom perception therefore seems to vary according to the interviewing method used.

People's prior knowledge of the possible effects of MTBI could also interact with the perception and identification of symptoms. A study by Mulhern and McMillan (2006) based on clinical vignettes depicting various medical conditions concluded that individuals in the general population usually have difficulty describing the main symptoms that could be associated with the MTBI because they do not know what it is. Thus, the manner in which people interpret their symptoms may be influenced by what they know or believe about their health — or by their lack of knowledge. Since MTBI symptoms do not easily come to people's minds without prompting (MacKenzie & McMillan, 2005), the interviewing method based on symptoms read from a checklist may, by its very nature, lead to a larger number of symptoms being reported. The results of the present study support this argument; the symptoms reported were significantly greater for the checklist method than for the free-report method. Thus, participants could more easily associate symptoms with their MTBI when a set of specific symptoms were presented to them, because they may have had a less detailed concept of this clinical entity and its possible symptoms. Moreover, the physical symptoms identified by certain participants as resulting from their MTBI varied considerably for the free-report method and sometimes prove to be not directly attributable to MTBI. It is therefore plausible that these participants had vague or limited knowledge of the realities of MTBI. Moreover, participants' knowledge about their post-accidental condition — or their skill in describing it — may not have increased over time given that the discrepancy in the number of reported symptoms between the two interviewing methods remained unchanged at each measurement interval.

The degree to which an individual may be swayed by the items in the checklist may affect the manner in which they report their symptoms. According to Mulhern and McMillan (2006) in a study conducted with participants from the general population, the ability to identify MTBI-related symptoms proved higher when using a checklist (versus during a 'free screening'), probably because of the participants' propensity for symptom-guessing. Moreover, using a checklist could be seen as an involuntary or voluntary means of 'teaching' about the possible consequences of MTBI (especially when financial compensation is involved) and consequently increase the number of symptoms reported (Carroll et al., 2004b; Wong, Regennitter, & Barrios, 1994). This could lead to a response bias of systematically responding incorrectly during a medical or psychological examination (Lees-Haley & Brown, 1993). Thus, individuals with MTBI symptoms seem to become suggestible when given a checklist of symptoms presented as being typical. In the context of the present study, it is therefore possible that the checklist method differs from the free-report method in that participants may be more inclined to overstate their symptoms when presented with a list. It would be important to study the phenomenon of over-reporting symptoms more thoroughly by comparing both interviewing methods in the context of financially compensated evaluations. The prospect of financial gain could well motivate an individual to report a greater number of symptoms in a checklist than would be reported freely. The difference in reported symptoms between the interviewing methods could therefore be greater in a more suggestible group prone to exaggeration and bias responses. Such a result would

provide further evidence that the checklist method encourages agreement with proposed symptoms.

The differences between the checklist method and the free-report method raise a major issue regarding the use of checklist-type questionnaires in the symptom self-evaluation after an MTBI: Do they allow greater accuracy in the identification of symptoms, or, on the contrary, do they encourage identification of symptoms that may be unrelated to the MTBI?

In the case of the former, reading a set of typical symptoms from checklist could lead to a more exhaustive evaluation. This argument may be based on the fact that individuals who sustained an MTBI most often allude to certain types of symptoms, particularly those of a physical nature such as headaches, fatigue, dizziness, or insomnia. Therefore, it is possible that severe or debilitating symptoms may worry the individual with MTBI to the point where they dismiss or even ignore less obvious symptoms. It could prove necessary to include cognitive and especially psychological items in the checklist, given that individuals are less inclined to attribute these symptoms to their MTBI. A checklist supplemented in this way would have the added advantage of bringing certain commonly ignored or omitted symptoms to the attention of the individuals concerned. Moreover, certain symptoms that were reported in the free-report method but not in the checklist method may be worthy of special clinical consideration even if their relationship with MTBI remains more or less clear. For example, it may be useful to know that an individual has experienced persistent pain since their MTBI if this symptom tends to interfere with other reported symptoms. If so, perhaps a free-report

measure of symptoms ought to precede the administration of the checklist questionnaire and therefore become the avenue to pursue both clinically and in research.

In the latter case, however, presenting symptoms in a checklist could compromise the validity of screening. This claim may be particularly true of certain MTBI individuals for whom self-reported symptoms differ widely depending on the interviewing method used. In the context of our results, it may be best to limit the number of symptoms in checklist-based interviews, since hearing this list apparently led participants to report symptoms that were rarely identified in the free-report method. Presenting a greater number of symptoms on the list might increase the symptoms reported yet yield no greater accuracy in evaluations because of the tendency to agree with the symptoms proposed. Allowing for the possibility that the checklist method results in reporting of symptoms not truly arising from the MTBI, it is recommended that such results be interpreted with a critical eye and examined in the context of other clinical data. These data primarily relate to the personal or environmental factors that can interact with self-reported symptoms following MTBI and influence the response patterns during the evaluation. This interaction with symptom reporting may result from other physical conditions (e.g. orthopaedic injuries), motivational influences (e.g. financial compensation), or psychological aspects (e.g. exposure to stress). It is therefore important to keep these additional factors in mind when attempting to explain symptoms and when determining appropriate recommendations for intervention.

Conclusion

In conclusion, the chief outcome of this study is to emphasize that the symptoms reported following an MTBI may vary depending on the interviewing method used. A greater number of symptoms was reported in the checklist method, whereas a greater diversity of symptoms was reported in the free-report method. Our findings on the acute phase post-MTBI are consistent with a study previously carried out by our team (Nolin, Villemure, & Héroux, 2006) in the same area but in 12–36 months of recovery. In light of the results presented in both these studies, it is highly likely that using the checklist method can lead to an inflated number of reported symptoms, while at the same time yield a more exhaustive evaluation. To be sure, the individuals' perception of their own symptoms may vary depending on the approach used. We feel that some measure based on free reporting — integrated before the conventional checklist-type questionnaire — could prove useful in limiting overevaluation of symptoms. In fact, a deeper investigation of those symptoms that were reported differently between the two interviewing methods could be conducted either through further questioning by the examiner or, if necessary, through more objective indicators such as cognitive tests or psychological questionnaires. Therefore, we recommend the free-report method and the checklist method as a complement to one another. We feel that clinicians should take this recommendation into account in addition to maintaining a cautious approach in interpreting symptoms reported after an MTBI. Further research is needed to deepen our understanding of the results presented in this study and to determine their clinical significance. Such research could be conducted in face-to-face meetings (as opposed to

by telephone) for a more authentic look at the clinical reality. This would afford the examiner the opportunity to question the participant on the factors that explain the difference between the free-report method and the checklist method. This research is key to arriving at a deeper understanding of the underlying factors that explain how interviewing method influences the manner in which individuals report their symptoms following an MTBI.

Acknowledgements

The authors would like to acknowledge the cooperation of the five hospital teams that participated in recruiting participants. We would especially like to thank Patricia Chabot and Valérie Murat at the Centre hospitalier affilié universitaire de Québec for their remarkable work. This study was also made possible through the support of the Fonds de la recherche en santé du Québec (FRSQ) and the Canadian Institutes of Health Research (CIHR).

Declaration of interest

The authors report no declarations of interest. The authors alone are responsible for the content and writing of the paper.

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Tables and figures

Table 1

Distribution of participants according to diagnostic criteria of the Task Force definition

Diagnostic criterion	Participants (n = 354)		
	Frequency	Average time (minutes)	%
Confusion/disorientation			
Yes	200	73.96	56.5
No	102		28.8
Uncertain	52		14.7
Loss of consciousness			
Yes	212	2.98	59.9
No	75		21.2
Uncertain	67		18.9
Post-traumatic amnesia			
Yes	271	62.18	76.6
No	80		22.0
Uncertain	3		0.8
Transient neurological abnormalities			
Yes	53		15.0
No	301		85.0
Glasgow Coma Scale score			
15	284		80.2
14	66		18.6
13	4		1.1

Table 2

Averages and standard deviations of total symptom by interviewing method and by measurement interval

Interviewing method	Measurement interval	Average	Standard deviation
Free-report	Week 1	1.39	1.22
Free-report	Week 4	0.85	1.17
Free-report	Week 12	0.57	1.09
Checklist	Week 1	4.27	3.50
Checklist	Week 4	2.98	3.44
Checklist	Week 12	2.00	2.89

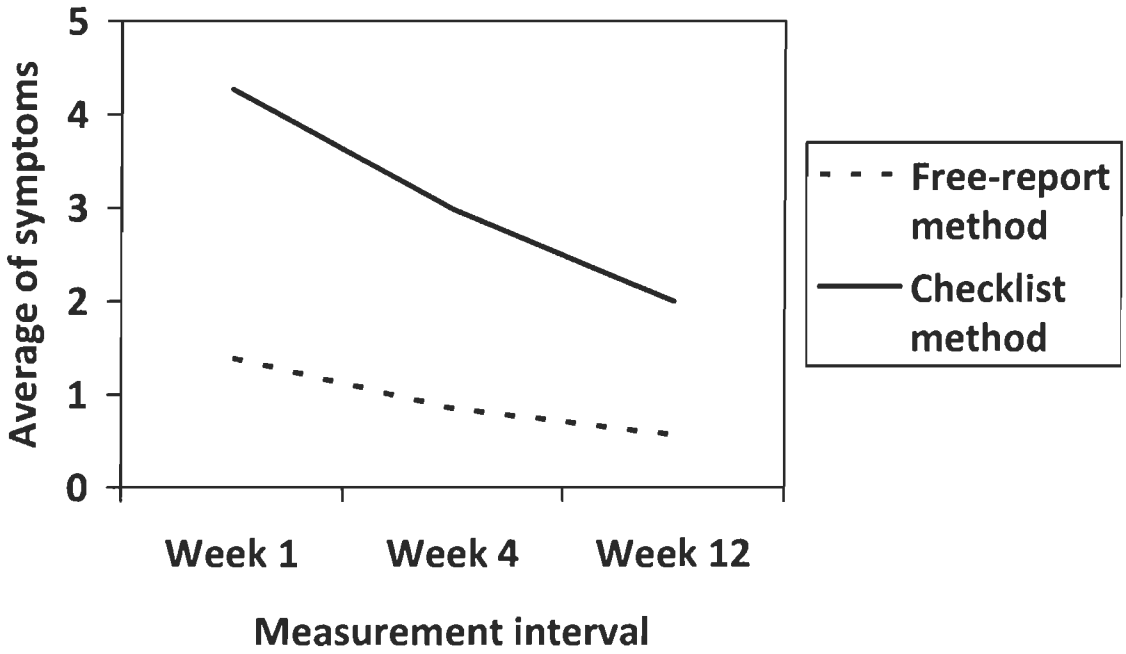

Figure 1. Interaction between interviewing method and measurement interval

Table 3

Frequencies and percentages of symptoms by interviewing method and by measurement interval

	Measurement interval					
	Week 1		Week 4		Week 12	
	Interviewing method					
Symptom	Free-report	Checklist	Free-report	Checklist	Free-report	Checklist
Cognitive						
Forgetfulness, poor memory	23(6.50%)	104(29.38%)	26(7.34%)	98(27.68%)	24(6.78%)	80(22.60%)
Poor concentration	27(7.63%)	135(38.14%)	15(4.24%)	90(25.42%)	13(3.67%)	76(21.47%)
Taking longer to think	7(1.98%)	124(35.03%)	3(0.85%)	72(20.34%)	2(0.56%)	38(10.73%)
Difficulty finding words	4(1.13%)	-	2(0.56%)	-	3(0.85%)	-
Difficulty evaluating distances	1(0.28%)	-	-	-	-	-
Psychological						
Being irritable, easily angered	3(0.85%)	85(24.01%)	3(0.85%)	81(22.88%)	6(1.69%)	54(15.25%)
Feeling depressed or tearful	1(0.28%)	40(11.30%)	-	19(5.37%)	4(1.13%)	25(7.06%)
Feeling frustrated or impatient	-	75(21.19%)	3(0.85%)	68(19.21%)	2(0.56%)	43(12.15%)
Restlessness	-	26(7.35%)	-	21(5.93%)	-	11(3.11%)
Change in personality	1(0.28%)	-	2(0.56%)	-	-	-
Anxiety or nervousness	1(0.28%)	-	2(0.56%)	-	3(0.85%)	-
Emotional sensitivity	1(0.28%)	-	1(0.28%)	-	1(0.28%)	-
Loss of interest	1(0.28%)	-	-	-	2(0.56%)	-
Physical						
Headaches	135(38.14%)	185(52.26%)	68(19.21%)	104(29.38%)	42(11.86%)	66(18.64%)
Feeling of dizziness	66(18.64%)	164(46.33%)	40(11.30%)	89(25.14%)	20(5.65%)	54(15.25%)
Nausea/vomiting	16(4.52%)	42(11.86%)	8(2.26%)	20(5.65%)	-	3(0.85%)
Noise sensitivity	-	75(21.19%)	-	58(16.38%)	2(0.56%)	39(11.02%)
Sleep disturbance	15(4.24%)	137(38.70%)	11(3.11%)	111(31.36%)	8(2.26%)	69(19.49%)
Fatigue, tiring more easily	55(15.54%)	239(67.51%)	27(7.63%)	160(45.20%)	18(5.08%)	114(32.20%)
Blurred vision	6(1.69%)	37(10.45%)	2(0.56%)	32(9.04%)	4(1.13%)	19(5.37%)
Light sensitivity	-	32(9.04%)	1(0.28%)	23(6.50%)	3(0.85%)	12(3.39%)
Double vision	2(0.56)	12(3.39%)	2(0.56%)	8(2.26%)	3(0.85%)	6(1.69%)
Physical pain	106(29.94%)	-	63(17.80%)	-	24(6.78%)	-
Balance problems	7(1.98%)	-	9(2.54%)	-	7(1.98%)	-
Hearing problems	2(0.56%)	-	3(0.85%)	-	3(0.85%)	-
Numbness	5(1.41%)	-	4(1.13%)	-	2(0.56%)	-
Loss of appetite	3(0.85%)	-	2(0.56%)	-	1(0.28%)	-
Diminishing sense of taste	-	-	1(0.28%)	-	1(0.28%)	-
Muscle stiffness	1(0.28%)	-	1(0.28%)	-	1(0.28%)	-
Black-spot vision	1(0.28%)	-	1(0.28%)	-	-	-
Cardiac palpitations	1(0.28%)	-	-	-	-	-

Appendix

Post-MTBI symptom evaluation: Interviewing methods

Name of participant: _____

File number: _____

Date of injury: _____

Date of questionnaire: _____

1. *Free-report method*

Instruction: "I would like to first know whether you still have symptoms from your mild traumatic brain injury, and, if so, which ones?"

_____

_____

_____

_____

_____

2. *Checklist method*

Instruction: "I am now going to read a list of symptoms. For each symptom, I would like you to tell me whether you currently have (within the past 24 hours) this symptom from your mild traumatic brain injury."

A list of symptoms taken from the Rivermead Post Concussion Symptoms Questionnaire (RPQ; King, Crawford, Wenden, Moss, & Wade, 1995) was presented to each participant.

1. Headaches..... yes no
2. Feelings of dizziness..... yes no
3. Nausea and/or Vomiting..... yes no
4. Noise sensitivity, easily upset by loud noise..... yes no
5. Sleep disturbance..... yes no
6. Fatigue, tiring more easily..... yes no
7. Being irritable, easily angered..... yes no
8. Feeling depressed or tearful..... yes no
9. Feeling frustrated or impatient..... yes no
10. Forgetfulness, poor memory..... yes no
11. Poor concentration..... yes no
12. Taking longer to think..... yes no
13. Blurred vision..... yes no
14. Light sensitivity, easily upset by bright light..... yes no
15. Double vision..... yes no
16. Restlessness..... yes no