Chapter 1

General Introduction
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This is a dissertation on mild traumatic injury, a neurological disorder that is also commonly referred to as mild head injury or concussion. Although sounding relatively innocent, for a minority of patients these injuries can have major consequences. This sharp contrast between severity and consequences is the motivation for this PhD research, which is dedicated to study the factors that influence outcome after mild traumatic brain injury, and investigate options to improve recovery after mild traumatic brain injury.

Introducing mild traumatic brain injury

Mild traumatic brain injury (mTBI) is very common, accounting for over 90% of all TBIs and affecting at least 600 of every 100,000 adults each year. mTBI is defined as a blunt impact to the head with sudden acceleration, deceleration or rotation resulting in physiological disruption of brain function. This disruption is manifested by a period of loss of consciousness (LOC) shorter than 30 minutes and/or a period of a confused state after injury (posttraumatic amnesia; PTA) not greater than 24 hours. These manifestations are mostly the effect of a functional disturbance than a structural injury. Less than 10% of mTBI patients have injuries that are identifiable with standard neuroimaging like Computed Tomography (CT), and the majority of mTBI patients that are seen at the emergency department are discharged home the same day. Almost all patients report posttraumatic complaints such as headache, dizziness, fatigue, irritability and forgetfulness in the early phase after injury. The majority of these patients will recover within 3 months and will return to their previous level of functioning. However, a subgroup of 15-25% of patients experience complaints that persist to even years after the injury, interfering with their resumption of previous activities, making loss of work productivity one of the largest components in economic costs of TBI. This unfortunate subgroup has the dubious honor of receiving its own name in literature: the “miserable minority”.

The miserable minority

Although atypical, having persisting complaints following mTBI has been a well-documented phenomenon, and the etiology of this adverse outcome has been subject of debate as long as this condition has been recognized. The name Post-Concussive syndrome (PCS) has been used as a definition of persistent complaints and poor outcome following mTBI for many years. However, the World Health Organization (WHO) cautioned against the use of this term, stating that it implied causation where this has not yet been proven. Therefore, persistent posttraumatic complaints (PTC) will be used throughout this dissertation to describe the patients with persistent symptoms. With regard to the often-debated cause of persisting complaints following mTBI, the oldest view dates back to 1988 and was formulated by Lishman. He stated that organic factors are relevant in the early stages, and secondary neurotic developments are to blame for the perpetuation of posttraumatic complaints. In today’s literature, the most dominant view is that already from the outset, there is a complex interplay of organic, psychological and social factors such as the injury itself, life stressors and pre-morbid health status. Severity of injury measures have found to be poor predictors of outcome, and patients with mTBI and persistent cognitive complaints do not perform worse on cognitive neuropsychological tests. Therefore, it is likely that pre-existent patient
characteristics such as personality traits (e.g. neuroticism) and psychological status (e.g. feelings of depression or anxiety) can create unrealistic illness perceptions and hence the subsequent exacerbation and maintenance of complaints. Apparently, some patients are less able to cope with the consequences of the injury than others. Coping refers to the way a person deals with and adapts to a distressing life event such as suffering from mTBI, and plays an important role in outcome following mTBI.

**Treatment of persistent complaints**  
Considering the large role of emotional and psychological factors in persisting complaints, many studies have focused on psychological treatments to improve patients’ functioning. A preferred choice of treatment for the present is cognitive behavioral therapy (CBT), for its potential in targeting unrealistic illness perceptions, enhancing coping skills and improving adaptive behavior to improve outcome. However, treatment of patients in the chronic phase has proven to be challenging, and the results are unsatisfactory. Although patients improved with regard to feelings of depression and anxiety, improvements in daily life functioning did not take place. Many studies therefore, have focused their efforts in preventing rather than treating persisting complaints. For example, giving psycho-education early after injury has been found to reduce posttraumatic complaints three months after injury. A similar result was attained by using CBT early after mTBI, in which patients showed a reduction in complaints and depression scores. The results from early interventions with psycho-education and CBT seem promising. However, no intervention to this date has proved capable to achieve its ultimate goal: improve functional outcome and facilitate a more successful return to work.

**The UPFRONT-study**  
This dissertation represents part of the results of an extensive Dutch multicenter prospective cohort study aimed at early identification and treatment of adaptive deficits and follow-up of patients with mTBI: The UPFRONT-study. The study had three arms with different objectives: (1) longitudinal follow-up in order to determine the influence of early adaptive deficits on outcome of patients with mTBI; (2) evaluating the effectiveness of an early psychological intervention with cognitive behavioral therapy in reducing complaints and improving work resumption following mTBI; (3) investigating the relationship between brain networks, adaptive deficits and emotion regulation in patients with mTBI with functional and structural neuroimaging. This dissertation touches upon all three objectives, but has its emphasis on the first two projects.

**Outline of dissertation**  
The most important objective of this dissertation is to investigate an intervention aimed at improving recovery after mild traumatic brain injury, and facilitate a more accurate identification of mTBI patients who would benefit the most from this additional aftercare. This dissertation starts with a general introduction to the subject (Chapter 1). Chapter 2 presents our newly developed CBT-based intervention, with details of the treatment protocol and rationale for treating at-risk mTBI patients with this intervention. Chapter 3 presents our randomized controlled trial that compares two psychological interventions for mTBI patients that are at risk of suffering from persisting complaints. We compared the CBT intervention described in Chapter 2 with telephonic counseling on their ability to positively influence
return to work and outcome, and reducing complaints and levels of anxiety and depression. **Chapter 4** comprises an in-depth discussion on the importance of coping styles, self-efficacy and the stability of coping over time after mTBI. Our efforts to establish a more accurate way of identifying mTBI patients that will most likely develop persisting complaints is presented in **chapter 5**, in which we aimed to find risk factors in addition to complaints. **Chapter 6** presents a study on the characteristics and outcome of a large and important subgroup of mTBI patients: the patients that were intoxicated with alcohol at the time of injury. With **chapter 7**, we attempted a completely new approach in finding out which patients are at-risk by focusing solely on a very interesting group consisting of patients with no complaints at all. This dissertation will close off with a general discussion (**Chapter 8**) of all the preceding articles, in which final conclusions are drawn. **Chapter 9** comprises a Dutch summary of this dissertation.
References


Identification and treatment of at-risk mTBI patients

PART II
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