The implications of head injuries for higher education: Evidence from psychology students

John T.E. Richardson, The Open University

Roughly 20 per cent of all students in higher education have sustained clinically significant head injuries during childhood or adolescence. Although these injuries typically do not seem to lead to any long-term intellectual deficits, little is known about their possible impact upon the students' academic attainment. Nevertheless, many head-injured students report a wide range of cognitive and emotional symptoms. Helping students to deal with this distress is a major challenge for academic, administrative and support staff in higher education.

ACADEMIC AND ADMINISTRATIVE staff in institutions of higher education tend to pay little attention to the medical histories of their students unless they have some ongoing condition that specifically interferes with their capacity for studying or with their academic attainment. (In this situation, of course, the obligations of institutions of higher education in the UK are prescribed by the 2001 Special Educational Needs and Disability Act. In other countries, there may exist similar legislation, such as the Americans with Disabilities Act.) They will in any case find little in the way of support in published material about particular medical conditions, because this sort of material tends to provide general advice about the impact that those conditions have on the general public, and it offers little guidance that is specific to people with those conditions who are studying in higher education.

An exception to this trend is the literature that has accumulated in the last 20 years on the consequences of head injuries sustained during childhood or adolescence. In this article, I will review this body of literature and argue that it has important implications for academic, administrative, and counselling staff working in institutions of higher education. I will aim to show, in particular:

- that a history of a clinically significant head injury is relatively common;
- that these injuries do not appear to lead to any long-term intellectual deficits; but
- that many head-injured students report a high level of emotional distress.

The relevant literature is contained in specialist journals in neurology and neuropsychology, but I will endeavour to make the main findings intelligible to a general academic readership.

The incidence, consequences and prevalence of head injuries

Head injuries are a common outcome of vehicular, occupational, domestic, and recreational accidents. Each year in Britain, more than 600,000 people sustain a head injury sufficiently serious to lead them to seek medical treatment at a hospital. The number of people who are hospitalised following head injuries has fluctuated in recent years as the result of changes in public behaviour, admissions policies, and clinical practices. Even so, at least 120,000 people are admitted to British hospitals each year for treatment after head injuries. More than half of all head-injured patients treated in hospital are children or adolescents. A very similar picture is found in the US and other industrialised countries (Richardson, 2000, pp.16–24).

Clinicians classify head injuries as being 'severe' or 'mild' based on a variety of criteria: the duration of coma (the state of unconsciousness that results); the depth of coma on admission to hospital; the duration of post-traumatic amnesia (i.e. the state of confusion that occurs on recovery from coma); the duration of hospitalisation; or the quality of the eventual outcome. Severe head injuries often give rise to pronounced and persistent impairments of memory and other intellectual functions, as well as disturbances of personality and behaviour (Richardson, 2000, pp.6–16, 207–216). In children and adolescents, these problems often lead to poor educational attainment (Heiskanen & Kaste, 1974; Kinsella *et al.*, 1997; Rivara *et al.*, 1994).

Nevertheless, the vast majority of head injuries are classified as 'mild' (see Kraus, 1993). For instance, in both the UK and the US, only 20 per cent of all people who seek treatment after head injuries are subsequently admitted to hospital (Richardson, 2000, pp.18–20). Even so, provided they are associated with a loss of consciousness, however brief, mild head injuries can give rise to brain damage. This was originally shown in post-mortem studies of head-injured patients who had died from unrelated causes, and it has been confirmed using modern brain imaging techniques (Richardson, 2000, pp.39–40, 54–55). However, the resulting lesions rarely require any kind of surgical intervention, and they often resolve within a few months following the accident (Levin *et al.*, 1987).

In children, mild head injuries tend not to give rise to any obvious persistent deficits (Bijur, Haslum & Golding, 1990; Levin, Ewing-Cobbs & Fletcher, 1989). Indeed, one review has concluded that any effects of mild injuries typically resolved within six months and were not associated with long-term changes in either academic attainment or behavioural functioning (Satz *et al.*, 1997). However, this conclusion was based on the results of studies carried out with groups of children and does not rule out the possibility that individual children within those groups might exhibit persistent and clinically significant deficits. Indeed, a proportion of children with mild head injuries do report persistent postconcussional symptoms. It is not clear whether these are associated with intellectual deficits (Ponsford *et al.*, 1999; Yeates *et al.*, 1999), but they do seem to affect educational attainment in primary (elementary) school (Rosen & Gerring, 1986).

The figures given above for the annual incidence of head injuries (i.e. the number of people who have a head injury in each year) are cumulative over the life span, so that the *prevalence* of head injuries (i.e. the number of people who have had head injuries) is much higher. One Swedish survey suggested that the prevalence of head injuries in male adults from the general population was around 21 to 26 per cent (Carlsson, Svardsudd & Welin, 1987), and Canadian surveys involving people of all ages and both sexes produced estimates as high as 30 per cent (Segalowitz, Lawson & Berge, 1993). The chances of having had a head injury are fairly high even during adolescence: two different surveys of students at Canadian high schools found that 19 per cent of the boys and 11 per cent of the girls reported that they had previously sustained a head injury that had caused loss of consciousness (Segalowitz & Brown, 1991; Segalowitz & Lawson, 1995).

In short, a substantial proportion of the population will have sustained head injuries by the time that they are eligible to participate in higher education. Those who have suffered more severe injuries are likely to have profound residual disabilities that may preclude access to higher education. Even so, the Special Educational Needs and Disability Act in the UK and the Americans with Disabilities Act in the US oblige institutions of higher education to make adjustments to their programmes and facilities to enable students with such disabilities to achieve the same access as students without disabilities, and Ruoff (2001) provided practical suggestions aimed at supporting such people in higher education.

In contrast, there are many more children and adolescents who sustain mild head injuries. In the mass systems of higher education that now prevail in most industrialised countries, they may be just as likely to proceed to higher education as their non-injured peers. Many of these people may be entirely free from residual forms of impairment or persistent symptoms. However, others may continue to suffer from subtle intellectual deficits and to experience a variety of postconcussional symptoms. In principle, these might disrupt their academic achievement in higher education and detract from their experience of the educational process as a whole.

The prevalence of head injuries among students in higher education

Virtually all estimates of the prevalence of head injuries in higher education are based upon students' self-reported medical histories. Apart from the practical convenience of being able to obtain the relevant information through students' self-reports, access to medical records is often precluded by either practical or ethical considerations. Crovitz, Horn and Daniel (1983) also claimed that the records held by institutional medical centres typically did not provide an accurate account of students' medical histories, at least with regard to previous head injuries. In principle, self-reported medical histories may be vulnerable to distortion or fabrication, but most researchers consider that self-reports do provide accurate accounts of patients' histories.

The majority of research into the prevalence and consequences of head injuries in higher education has involved students who were taking courses in psychology, which means that they are likely to include disproportionate numbers of women. This is relevant, because men are more likely to sustain head injuries than women, a trend that is especially pronounced in young adults (Richardson, 2000, pp.23–24). Otherwise, however, there is no obvious reason why similar findings would not be obtained in students taking courses in other academic disciplines (Segalowitz & Lawson, 1995). A more important reservation is that none of the surveys provided any information on response rates: students who respond to surveys are known to differ from non-respondents in their attainment and many other characteristics (Astin, 1970; Nielsen, Moos & Lee, 1978), so any survey that falls short of a 100 per cent response rate may be vulnerable to sampling bias.

Crovitz *et al.* (1983) surveyed 1000 students at two institutions in the US. They found that 24 per cent of the men and 16 per cent of the women reported having been 'knocked out by a head injury' at some point in their lives. Crovitz and Daniel (1987) assessed 2496 students taking introductory psychology courses at one institution of higher education and found that 24 per cent of the men and 12 per cent of the women reported having had a head injury. In another survey of 420 students at the same institution, Crovitz, Diaco and Apter (1992) obtained almost identical figures of 23 per cent and 12 per cent, respectively. Segalowitz and Lawson (1995) surveyed three successive cohorts (totalling 2321 students) at one Canadian institution, and they found that 16.6 per cent of the men and 7.3 per cent of the women reported having had a head injury causing loss of consciousness. Finally, Ryan *et al.* (1996) carried out a study of 800 students at a university in the US, and they found that 188 (or 23 per cent) of the students reported having sustained a head injury that had resulted in at least a momentary loss of consciousness.

The exact findings of these surveys clearly vary from one study to another, partly depending upon the student population being surveyed, and partly depending upon how their self-reports were obtained. Nevertheless, one can infer that the prevalence of clinically significant head injuries (in other words, those associated with some loss of consciousness) among students in higher education is between 12 per cent and 23 per cent. In studies that reported their findings by gender, the corresponding estimates have varied between 16 per cent and 24 per cent in men and between seven per cent and 16 per cent in women. These figures are comparable with estimates obtained both from high-school students and from the general adult population (Segalowitz & Lawson, 1995). This provides indirect evidence that a history of head injury during childhood or adolescence is apparently not incompatible with participation in higher education. However, are head-injured students able to cope with the academic demands of their courses?

Intellectual functioning in head-injured students

As mentioned earlier, mild head injuries tend not to give rise to persistent intellectual deficits in children, and the same is true in adults (see Binder, Rohling & Larrabee, 1997). One might, therefore, expect many students who have suffered head injuries in childhood, adolescence, or early adulthood to produce intact performance on objective tests of intellectual functioning.

In an experiment carried out in New Zealand, Ewing *et al.* (1980) identified 10 students who had sustained head injuries between one and three years earlier but whose performance on psychological tests had returned to normal levels. The students were assessed on a battery of cognitive tests under conditions of mild oxygen deficiency that were induced in a hypobaric chamber. They showed a statistically significant impairment in comparison with 10 non-injured students who were tested under the same conditions. Ewing *et al.* concluded that head injuries gave rise to persistent deficits in intellectual functioning, but that these might be relatively subtle and might emerge only under conditions of relative stress. It should, however, be noted that the effects which they observed were relatively slight and were probably due to the inclusion of three students with somewhat more severe injuries.

Hayes, Martin and Gouvier (1995) gave a battery of psychological tests to 42 head-injured students and 45 non-injured students. They also administered a questionnaire that measured the students' prior knowledge about the effects of head injuries. Within each of the groups, roughly half the students were asked to do their best on the relevant tests, but the rest of the students were asked to simulate impaired functioning in order to check whether any apparent deficits might actually be a result of malingering. Not surprisingly, the students who had been instructed to malinger produced poorer performance than the students who had been told to do their best, but their performance was unrelated to their level of prior knowledge about the effects of head injuries. In addition, there was no statistically significant difference between the performance of the head-injured students and the non-injured students on any of the tests.

Bernstein and de Ruiter (2000) similarly administered a battery of psychological tests to 40 head-injured students and 31 non-injured students. In each group, roughly half the students were not given any special instructions, and in these circumstances there were no statistically significant differences between the scores obtained by the head-injured students and those obtained by the non-injured students. To increase their motivation, the rest of the students were told that their performance was an indicator of how well they could expect to do at university. These instructions tended to enhance the performance of the non-injured students on some of the tasks (though not all); however, they had little or no effect on the performance of the head-injured students. As a result, under conditions of enhanced motivation, the head-injured students tended to perform less well than the non-injured students. This pattern could suggest that people with a history of head injury are able to perform adequately in normal circumstances but are unable to deploy additional resources in more demanding conditions. One proviso, however, is that it was mainly due to the relatively poor performance on just one test of a small number of students who had a history of more than one head injury.

Cudmore, Segalowitz and Dywan (2000) tested students with and without a history of mild head injury on a task that required auditory vigilance. The students carried out both easy and hard versions of the task, either on their own or while they were simultaneously carrying out a separate test of short-term memory. The head-injured students and the non-injured students produced similar levels of performance under all of the experimental conditions. While they were carrying out these different tasks, their brain activity was being monitored by means of an electroencephalogram (EEG). The addition of the secondary task had little effect upon the EEG data obtained from the non-injured students. In the head-injured students, however, it led to a statistically significant increase in the amount of synchrony among the EEG patterns in different brain regions. Cudmore *et al.* took this to mean that the head-injured students had subtle intellectual deficits, and that they had been forced to recruit additional resources from different regions of the brain to cope with the demands of the additional secondary task.

Marschark *et al.* (2000) administered a battery of psychological tests to 79 students with a history of head injury and to two comparison groups: 75 students with a history of having undergone general anaesthesia for a major medical or dental procedure and 93 students with no history of either head injury or general anaesthesia. They found no statistically significant differences among the three groups across a variety of tasks tapping verbal and non-verbal aspects of memory and intellectual functioning. Indeed, on several of the tests, the head-injured students tended to produce somewhat higher scores than either of the two comparison groups.

All these findings are consistent with the idea that students with a history of mild head injury do not show persistent intellectual deficits, although there are two contrary suggestions. One is that head-injured students have residual brain damage but are able to compensate for this by recruiting additional resources from intact brain regions (Cudmore *et al.*, 2000). The other is that head-injured students are impaired under conditions of high stress (Ewing *et al.*, 1980) or high motivation (Bernstein & de Ruiter, 2000). The latter conditions would presumably include classroom testing, formal examinations, and other forms of academic assessment, and it would clearly be interesting to examine the academic attainment of head-injured students.

Unfortunately, the only published data are contained in the study by Marschark *et al.* (2000). Their three groups (students with a history of head injury, a history of general anaesthesia or no history of either head injury or general anaesthesia) had not been deliberately matched on the basis of their academic qualifications, but Marschark *et al.* (2000) were able to obtain the scores which the students had achieved on the Scholastic Aptitude Test (SAT) before admission to university. There was in fact no sign of any difference among the three groups on either their verbal SAT scores or their quantitative SAT scores. Marschark *et al.* (2000) concluded that students with a history of mild head injury achieved normal scores on the SAT. Ewing *et al.* (1980) also remarked that the 10 head-injured students in their experiment had all returned to their studies and had academic records that were consistent with their level of attainment before their accidents. Of course, to the extent that head-injured students tend to produce normal scores on indicators of academic attainment, academics, administrators, and other staff will be less likely to notice any effects of mild head injury on other aspects of their behaviour.

Emotional functioning in head-injured students

Some people who have sustained mild head injuries (whether as children or adults) continue to complain of a variety of emotional symptoms, particularly depression, irritability, hostility, anxiety, and distractibility. It would seem that roughly 10 to 25 per cent of all people with a history of mild head injury experience persistent post-concussional symptoms of this nature (Brown, Fann & Grant, 1994; Mittenberg, Wittner & Miller, 1997; Rutherford, 1989). Modern brain imaging techniques have shown that these people may have significant residual brain damage (Kant *et al.*, 1997; Varney *et al.*, 1995). They also tend to produce poorer performance on tests of memory, attention, and other intellectual functions (Gass & Apple, 1997; Leininger *et al.*, 1990).

The first problem in evaluating these findings is that, although the relevant symptoms tend to be more common in people who have a history of head injury, they may also be reported by people with other medical conditions or by people (including students) who apparently have no medical conditions at all (e.g. Fox *et al.*, 1995; Gouvier, Uddo-Crane & Brown, 1988). Gouvier *et al.* (1992) administered two symptom checklists to 47 head-injured students and 50 non-injured students. The head-injured students reported more symptoms than the non-injured students, and they reported that their symptoms occurred more often. In a second study, Gouvier *et al.* (1992) found that symptoms were more likely to be reported by head-injured and non-injured students on more stressful days than on less stressful days. When the two groups were compared on their most and least stressful days, there were no significant differences between them in their symptom reports.

Ryan *et al.* (1996) similarly administered a symptom checklist to 151 head-injured students and 221 non-injured students. The head-injured students were asked to rate the frequency of their symptoms both before and after their injuries, while the non-injured students were asked to rate the frequency of their symptoms before and after their admission to higher education. The reports of the head-injured students showed a significant increase in the frequency of all the symptoms in the checklist following their injuries. However, the reports of the non-injured students also showed a significant increase in the frequency of some of the symptoms after their admission. There were no statistically significant differences between the post-injury ratings of the head-injured students and the post-admission ratings of the non-injured students, though the head-injured students produced higher ratings of the frequency of every symptom.

Santa Maria *et al.* (2001) recruited 98 participants from a sample of 2326 students who had received a questionnaire that included a symptom checklist. These participants represented men and women with or without a history of a head injury who had produced relatively high or low total scores on the symptom checklist. They were asked to complete the questionnaire for a second time between three and 90 days after its initial administration. Students with low symptom scores were more consistent in their responses between the two administrations than those with high symptom scores, and men were more consistent than women. However, the consistency of their symptom scores was essentially unrelated to whether or not the participants had actually sustained a head injury.

A second problem is that people who have sustained a mild head injury may complain of a wide variety of problems in social and behavioural functioning that are not confined to some identifiable ‘syndrome’. Segalowitz and Lawson (1995) asked the students in two of the three cohorts in their survey to rate how much difficulty they had had in different situations at school. The head-injured students reported significantly more difficulty than the non-injured students with arguing, fighting, daydreaming, feeling anxious, over-sensitivity, getting started on assignments and finishing assignments, feeling restless, depression, crying, apathy, falling asleep, and getting along with their teachers and peers. In addition, the head-injured students were more likely to report sleeping disorders and having been professionally diagnosed as having attention-deficit disorder, depression, and developmental speech or language disorders. The impact of such symptoms may be particularly severe in higher education, where students may be living away from home and on their own for the first time.

Bernstein and de Ruiter (2000) found no difference between head-injured and non-injured students in the incidence of intellectual or emotional symptoms. However, their head-injured students were more likely to complain of physical symptoms (such as fatigue, sleep problems, and nausea) and were more likely to report a medical problem (such as reading disability, depression or migraine). Marschark *et al.* (2000) asked the students in their investigation to report on their experience of symptoms in several different domains of social or emotional functioning using the Symptom Checklist 90 – Revised (SCL–90R) (Derogatis, Rickels & Rock, 1976). There were statistically significant differences among the three groups in all nine domains such that the head-injured students reported a higher level of symptomatology than either of the two comparison groups. Indeed, 56 per cent of the head-injured students fell at or beyond the cutoff representing a clinically significant level of symptomatology.

The SCL–90R was intended for use with populations of psychiatric or medical patients, but several of the scales contain symptoms that are characteristically reported by patients with a history of mild head injury. It follows that increased scores on these particular dimensions could be construed as reflecting a normal response to head injury rather than any pathological abnormality (Leathern & Babbage, 2000; O'Donnell, de Soto & Reynolds, 1984; Woessner & Caplan, 1995). Nevertheless, Marschark *et al.* (2000) found that students with a history of mild head injury exhibited a pattern of general elevation on all nine dimensions of the SCL–90R rather than a selective elevation on the dimensions that contained symptoms characteristic of head injury. Head-injured students are also more sensitive to being addressed in 'motherese', speech with high-pitched, exaggerated prosodic variations that professionals often use in talking to their clients (Gouvier *et al.*, 1992; Johnson *et al.*, 2002).

Finally, a number of studies have been carried out to differentiate between a history of head injury and reports of 'postconcussional' symptoms as predictors of intellectual functioning. Hanna-Pladdy *et al.* (2001) selected 88 students according to their responses to a questionnaire regarding their medical history and their current symptoms. The students represented people with or without a history of head injury who were classified as being either symptomatic or asymptomatic with regard to postconcussional symptoms. The symptomatic students obtained poorer scores than the asymptomatic students on a number of psychological tests. Although there were no statistically significant differences between the overall scores of the head-injured students and the non-injured students, the performance of the head-injured students was more vulnerable to disruption under conditions of high stress.

Pinkston, Gouvier and Santa Maria (2000) administered a battery of psychological tests to four groups each of 18 students selected to represent people with or without a history of mild head injury who either reported or did not report 'postconcussional' symptoms. There were no statistically significant differences between the head-injured students and the non-injured students on any of the tests. The asymptomatic students produced higher scores than the symptomatic students, but only on one of the tests. These studies confirm that a history of head injury *per se* is not associated with impaired intellectual functioning in students. There is some evidence that 'post-concussional' symptomatology is linked to impaired functioning, regardless of whether or not the symptoms in question have actually resulted from a previous head injury. It is, once again, unfortunate that none of the studies provided data on academic attainment, though the results obtained by Marschark *et al.* (2000) indicate that higher levels of postconcussional symptomatology are not associated with poorer scores on the SAT.

Conclusions and implications

The prevalence of head injuries among students in higher education is of the order of 20 per cent (and is typically higher in men than in women). On the one hand, as mentioned earlier, this figure suggests that a history of head injury is not incompatible with participation in higher education. On the other hand, it suggests that a substantial number of students are vulnerable to the consequences of head injuries. The results of research studies carried out with students are consistent with those of studies involving patients drawn from the general population in suggesting that mild head injuries do not typically lead to any long-term intellectual deficits. Nevertheless, this does not rule out the idea that some individuals do suffer from persistent but quite subtle forms of impairment that may well affect their academic performance. There is certainly an urgent need for comparative information about the attainment of head-injured and non-injured students on courses of study in higher education. At present, we simply do not know whether head-injured students perform as well as their non-injured peers.

Those students who have a history of mild head injury complain of a wide range of persistent symptoms. These include characteristic emotional symptoms, but they also include physical symptoms and medical conditions. Similar patterns of symptoms are seen in students who have not sustained head injuries, and it may be that these symptoms, rather than any specific history of head injury, are responsible for persistent intellectual impairment (which may or may not be apparent in poor academic attainment). Nevertheless, these symptoms are more common in students with a history of head injury, and in one recent study more than 50 per cent of all head-injured students showed clinically significant elevations on a widely used symptom checklist (Marschark *et al.*, 2000). In short, as many as 10 per cent (i.e. 50 per cent of 20 per cent) of the student population could be suffering from a clinically significant level of emotional distress following mild head injuries sustained during childhood or adolescence that is likely to disrupt their interpersonal functioning and their psychological well-being.

Whether this emotional distress actually results from the head injuries is an empirical issue, and it should be recognised that all of the evidence on head-injured students that has been reviewed in this article is correlational in nature. Strictly speaking, no inferences can be drawn concerning either the existence or the direction of any causal relationship between a history of head injury in students and their current symptomatology. However, this research issue is largely irrelevant to the more practical matter of supporting these students in higher education. Dealing with this level of emotional distress will constitute a major challenge for anyone involved in higher education: for academics, administrators, support staff, and, not least, for the students themselves.

Under the prevailing legislation in both the UK and the US, it is unclear whether these students would qualify as being ‘disabled’, since it would need to be demonstrated that their symptoms had a substantial effect upon their ability to carry out daily activities. Moreover, in the US, institutions are under no obligation to identify any disabilities in their students (McGuire, 1998). The onus is upon individual students to provide formal documentation of the nature and the extent of their disabilities; to show that they need specific adjustments or accommodations; and (if they wish to invoke the relevant legislation) to show that an institution has discriminated against them (Gordon & Keiser, 1998).

In the UK, it used to be similarly assumed that lack of knowledge about a student’s disability would provide a reasonable defence to the claim that an institution had treated the student unfavourably (Doyle & Robson, 2002, p.2). However, in 2000 a company was held to be liable under the Disability Discrimination Act (DDA) for treating an employee unfavourably without checking whether that employee's poor performance was the result of a disability (see Incomes Data Services, 2000, p.14). Under the Special Educational Needs and Disability Act (SENDA, which extended the DDA to include higher education), this decision would suggest that institutions of higher education need to take reasonable steps to establish whether or not their students are disabled (Knox, 2002).

Indeed, the SENDA imposes a legal obligation upon institutions to make adjustments to their programmes and their facilities in anticipation of admitting students with disabilities, rather than just trying to accommodate the disabilities of particular students after they have arrived. One would hope that, of all disciplines, teachers of psychology would appreciate the importance of creating a climate in which students felt secure in disclosing post-concussional symptoms and would be proactive in ensuring that the impact of such symptoms on students' performance was duly understood and taken into account in both teaching and assessment.

Acknowledgements
I am grateful to Drew Gouvier, James Hartley, Marc Marschark, Helen Morton, Colette Ray and Richard Stephens for their comments on previous versions of this article.

Correspondence
Professor John T.E. Richardson,
Institute of Educational Technology,
The Open University,
Walton Hall,
Milton Keynes MK7 6AA.
E-mail: J.T.E.Richardson@open.ac.uk

References
Astin, A.W. (1970). The methodology of research on college impact, Part I. *Sociology and Education, 43,* 437–450.

Bernstein, D.M. & de Ruiter, S.W. (2000). The influence of motivation on neurocognitive performance long after mild traumatic brain injury. *Brain and Cognition, 44,* 50–66.

Bijur, P.E., Haslum, M. & Golding, J. (1990). Cognitive and behavioural sequelae of mild head injury. *Pediatrics, 86,* 337–344.

Binder, L.M., Rohling M.L. & Larrabee, G.J. (1997). A review of mild head trauma: Part I. Meta-analytic review of neuropsychological studies. *Journal of Clinical and Experimental Neuropsychology, 19,* 421–431.

Brown, S.J., Fann J.R. & Grant, I. (1994). Post-concussional disorder: Time to acknowledge a common source of neurobehavioral morbidity. Journal of *Neuropsychiatry and Clinical Neuroscience, 6,* 15–22.

Carlsson, G.S., Svardsudd, K. & Welin, L. (1987). Long-term effects of head injuries sustained during life in three male populations. *Journal of Neurosurgery, 67,* 197–205.

Crovitz, H.F. & Daniel, W.F. (1987). Length of retrograde amnesia after head injury: A revised formula. *Cortex, 23,* 695–698.

Crovitz, H.F., Diaco, D.S. & Apter, A. (1992). Consistency in recalling features of former head injuries: Retrospective questionnaire vs. interview retest. *Cortex, 28,* 509–512.

Crovitz, H.F., Horn, R.W. & Daniel, W.F. (1983). Inter-relationships among retrograde amnesia, post-traumatic amnesia, and time since head injury: A retrospective study. *Cortex, 19,* 407–412.

Cudmore, L. J., Segalowitz, S. J. & Dywan, J. (2000). EEG coherence shows altered frontal-parietal communication in mild TBI during a dual-task. *Brain and Cognition, 44,* 86–90.

Derogatis, L.R., Rickels, K. & Rock, K. (1976). The SCL–90R and MMPI: A step in the validation of a new self-report scale. *British Journal of Psychiatry, 128,* 280–289.

Doyle, C. & Robson, K. (2002). *Accessible curricula: Good practice for all.* Cardiff: UWIC Press.

Ewing, R., McCarthy, D., Gronwall, D. & Wrightson, P. (1980). Persisting effects of minor head injury observable during hypoxic stress. *Journal of Clinical Neuropsychology, 2,* 147–155.

Fox, D.D., Lees-Haley, P.R., Earnest, K. & Dolezal-Wood, S. (1995). Base rates of postconcussive symptoms in health maintenance organization patients and controls. *Neuropsychology, 9,* 606–611.

Gass, C.S. & Apple, C. (1997). Cognitive complaints in closed-head injury: relationship to memory test performance and emotional disturbance. *Journal of Clinical and Experimental Neuropsychology, 19,* 290–299.

Gordon, M. & Keiser, S. (1998). Underpinnings. In M. Gordon & S. Keiser (Eds.), *Accommodations in Higher Education under the Americans with Disabilities Act (ADA): A no-nonsense guide for clinicians, educators, administrators and lawyers* (pp.3–19). De Witt, NY: GSI Publications.

Gouvier, W.D., Coon, R.C., Fuller, K.H. & Arnoldi, K.R. (1992). Evaluation of linguistic variations by college students with and without head injuries. *Rehabilitation Psychology, 37,* 165–174.

Gouvier, W.D., Cubic, B., Jones, G., Brantley, P. & Cutlip, Q. (1992). Post-concussion symptoms and daily stress in normal and head-injured college populations. *Archives of Clinical Neuropsychology, 7,* 193–211.

Gouvier, W.D., Uddo-Crane, M. & Brown, L.M. (1988). Base rates of post-concussional symptoms. *Archives of Clinical Neuropsychology, 3,* 273–278.

Hanna-Pladdy, B., Berry, Z., Bennett, T., Phillips, H. & Gouvier, W.D. (2001). Stress as a diagnostic challenge for post-concussive symptoms: Sequelae of mild traumatic brain injury or physiologic stress response. *The Clinical Neuropsychologist, 15,* 289–304.

Hayes, J.S., Martin, R. & Gouvier, W.D. (1995). Influence of prior knowledge and experience on the ability to feign mild head injury symptoms in head injured and non-head-injured college students. *Applied Neuropsychology, 2,* 63–66.

Heiskanen, O. & Kaste, M. (1974). Late prognosis of severe brain injury in children. *Developmental Medicine and Child Neurology, 16,* 11–14.

Incomes Data Services (2000). *Monitoring the Disability Discrimination Act 1995, Phase 2: First Interim Report to the Department for Education and Employment.* London: Incomes Data Services. Retrieved 10 April 2004 from http://www.incomesdata.co.uk/brief/dda/2reportb.pdf

Johnson, D.M., Dixon, D.R., Coon, R.C., Hilker, K. & Gouvier, W. D. (2002). Watch what you say and how you say it: differential response to speech by participants with and without head injuries. *Applied Neuropsychology, 9,* 58–62.

Kant, R., Smith-Seemiller, L., Isaac, G. & Duffy, J. (1997). Tc-HMPAO SPECT in persistent post-concussion syndrome after mild head injury: Comparison with MRI/CT. *Brain Injury, 11,* 115–124.

Kinsella, G.J., Prior, M., Sawyer, M., Ong, B., Murtagh, D., Eisenmajer, R., Bryan, D., Anderson, V. & Klug, G. (1997). Predictors and indicators of academic outcome in children two years following traumatic brain injury. *Journal of the International Neuropsychological Society, 3,* 608–616.

Knox, J. (2002). The Special Educational Needs and Disability Act: Guidance for Teaching Staff. Retrieved 6 April 2004 from http://jarmin.com/demos/course/senda/index.html

Kraus, J.F. (1993). Epidemiology of head injury. In P.R. Cooper (Ed.), *Head injury* (3rd ed., pp. 1–25). Baltimore, MD: Williams & Wilkins.

Leathern, J.M. & Babbage, D.R. (2000). Affective disorders after traumatic brain injury: Cautions in the use of the Symptom Checklist–90–R. *Journal of Head Trauma Rehabilitation, 15,* 1246–1255.

Leininger, B.E., Gramling, S.E., Farrell, A.D., Kreutzer, J.S. & Peck, E.A., III (1990). Neuropsychological deficits in symptomatic minor head patients after concussion and mild concussion. *Journal of Neurology, Neurosurgery, and Psychiatry, 53,* 293–296.

Levin, H.S., Amparo, E., Eisenberg, H.M., Williams, D.H., High, W.M., Jr., McArdle, C.B. & Weiner, R.L. (1987). Magnetic resonance imaging and computerised tomography in relation to the neurobehavioral sequelae of mild and moderate head injuries. *Journal of Neurosurgery, 66,* 706–713.

Levin, H.S., Ewing-Cobbs, L. & Fletcher, J.M. (1989). Neurobehavioral outcome of mild head injury in children. In H.S. Levin, H.M. Eisenberg & A.L. Benton (Eds.), *Mild head injury* (pp.189–213). New York: Oxford University Press.

Marschark, M., Richtsmeier, L.M., Richardson, J.T.E., Crovitz, H.F. & Henry, J. (2000). Intellectual and emotional functioning in college students following mild traumatic brain injury in childhood and adolescence. *Journal of Head Trauma Rehabilitation, 15,* 1227–1245.

McGuire, J. (1998). Educational accommodations: A university administrator's view. In M. Gordon & S. Keiser (Eds.), *Accommodations in Higher Education under the Americans with Disabilities Act (ADA): A no-nonsense guide for clinicians, educators, administrators and lawyers* (pp.20–45). De Witt, NY: GSI Publications.

Mittenberg, W., Wittner, M.S. & Miller, I.J. (1997). Post-concussion syndrome occurs in children. *Neuropsychology, 11,* 447–452.

Nielsen, H.D., Moos, R.H. & Lee, E.A. (1978). Response bias in follow-up studies of college students. *Research in Higher Education, 9,* 97–113.

O'Donnell, W.E., de Soto, C.B. & Reynolds, D.M. (1984). A cognitive deficit subscale of the SCL–90–R. *Journal of Clinical Psychology, 40,* 241–246.

Pinkston, J.B., Gouvier, W.D. & Santa Maria, M.P. (2000). Mild head injury: Differentiation of long-term differences on testing. *Brain and Cognition, 44,* 74–78.

Ponsford, J., Willmott, C., Rothwell, A., Cameron, P., Ayton, G., Nelms, R., Curran, C. & Ng, K.T. (1999). Cognitive and behavioural outcome following mild traumatic head injury in children. *Journal of Head Trauma Rehabilitation, 14,* 360–372.

Richardson, J.T.E. (2000). *Clinical and neuropsychological aspects of closed head injury* (2nd ed.). Hove: Psychology Press.

Rivara, J.B., Jaffe, K.M., Polissar, N.L., Fay, G.C., Martin, K.M., Shurtleff, H.A. & Liao, S. (1994). Family functioning and childrens' academic performance and behaviour problems in the year following traumatic brain injury. *Archives of Physical Medicine and Rehabilitation, 75,* 369–379.

Rosen, C. & Gerring, J. (1986). *Head trauma: Educational reintegration.* San Diego, CA: College-Hill Press.

Ruoff, J. (2001). *The student with a brain injury: Achieving goals for Higher Education.* Washington, DC: American Council on Education, HEATH Resource Center.

Rutherford, W.F. (1989). Post-concussion syndrome: Relationship to acute neurological indices, individual differences, and circumstances of injury. In H.S. Levin, H.M. Eisenberg & A.L. Benton (Eds.), *Mild head injury* (pp.217–228). New York: Oxford University Press.

Ryan, L.M., O'Jile, J.R., Gouvier, W.D., Parks-Levy, J. & Betz, B. (1996). Head injury in a college population: Analysis of epidemiological factors. *Applied Neuropsychology, 3,* 49–54.

Santa Maria, M.P., Pinkston, J.B., Miller, S.R. & Gouvier, W.D. (2001). Stability of post-concussion symptomatology differs between high and low responders and by gender but not by mild head injury status. *Archives of Clinical Neuropsychology, 16,* 133–140.

Satz, P., Zaucha, K., McCleary, C., Light, R., Asarnow, R. & Becker, D. (1997). Mild head injury in children and adolescents: A review of studies (1970–1995). *Psychological Bulletin, 122,* 107–131.

Segalowitz, S.J. & Brown, D. (1991). Mild head injury as a source of developmental disabilities. *Journal of Learning Disabilities, 24,* 551–559.

Segalowitz, S.J. & Lawson, S. (1995). Subtle symptoms associated with self-reported mild head injury. *Journal of Learning Disabilities, 29,* 309–319.

Segalowitz, S.J., Lawson, S. & Berge, B. (1993). Unreported head injury in the general population: Subtle residual effects (abstract). *Journal of Clinical and Experimental Neuropsychology, 15,* 104.

Varney, N.R., Bushnell, D.L., Nathan, M., Kahn, D., Roberts, R., Rezai, K., Walker, W. & Kirchner, P. (1995). NeuroSPECT correlates of disabling mild head injury: Preliminary findings. *Journal of Head Trauma Rehabilitation, 10*(3), 18–28.

Woessner, R. & Caplan, B. (1995). Affective disorders following mild to moderate brain injury: Interpretive hazards of the SCL–90–R. *Journal of Head Trauma Rehabilitation, 10*(2), 78–89.

Yeates, K.O., Luria, J., Bartkowski, H., Rusin, J., Martin, L. & Bigler, E.D. (1999). Post-concussive symptoms in children with mild closed head injuries. *Journal of Head Trauma Rehabilitation, 14,* 337–350.