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# LES CONSÉQUENCES DE CERTAINS TRAUMATISMES CRÂNIENS SÉVÈRES SUR LE NIVEAU D'AJUSTEMENT

par

Andrée Tellier

B.A. Université McGill, 1984

Une thèse
Soumise à la Faculté des Etudes Supérieures
par l'entremise du Département de Psychologie
en vue de répondre à une partie des Prérequis
d'une Maîtrise en Arts à l'Université de Windsor

Windsor, Ontario, Canada
1986

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# THE EFFECTS OF SEVERE CRANIOCEREBRAL TRAUMA ON ADJUSTMENT LEVEL

by

Andrée Tellier

B.A. McGill University, 1984

A thesis
Submitted to the Faculty of Graduate Studies
through the Department of Psychology
in Partial Fulfillment of the
Requirements for the Degree
of Master of Arts at the
University of Windsor

Windsor, Ontario, Canada
1986

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# RÉSUMÉ

Les conséquences à long terme de certains traumatismes crâniens sévères sur le niveau d'ajustement social furent étudiées. Les variables pouvant possiblement prédire les niveaux d'ajustement furent également explorées. Il fut predit qu'une blessure à la région antérieure gauche du cerveau entraînerait un niveau d'ajustement psychosocial moindre. Cinquante-deux vétérans de la Deuxième Guerre Mondiale ayant subi un traumatisme pénétrant au cerveau furent interrogés 40 ans après leur blessure en utilisant le Washington Psychosocial Seizure Inventory et le Subjective Memory Questionnaire. Les résultats supportèrent un impact différentiel de lésions droites et gauches. Cependant, contrairement à l'hypothèse énoncée, les groupes avec lésion au côté droit du cerveau obtinrent les niveaux d'adaptation les plus bas. Aucune relation ne fut établie entre les foyers de blessure et les difficultés psychosociales quoique les résultats ayant trait au groupe droit-antérieur sont remarquables en rapport avec des niveaux d'ajustement moindres. Ces resultats contribuent à une plus grande compréhension du cerveau humain et aide à la planification de programmes de réhabilitation pour de tels individus.



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## ABSTRACT

An investigation of the long-term effects of severe craniocerebral trauma on adjustment levels was carried out. In addition, an attempt was made at pinpointing possible predictors of adjustment levels. It was hypothesized that damage to the left anterior region of the brain would lead to lower levels of psychosocial adjustment. Fifty-two World War II Veterans who suffered penetrating injury to the brain were interviewed 40 years after their initial injury using the Washington Psychosocial Seizure Inventory and the Subjective Memory Questionnaire. The results supported a differential impact of right and left hemispheric lesions, with subjects who suffered damage to the right hemisphere obtaining the highest levels of maladjustment. No significant relationships were found between locus of damage (anterior and posterior) and psychosocial difficulties, although the results pertaining to the right-anterior group were salient with respect to higher maladjustment levels. These findings were discussed in terms of understanding the workings of the human brain and aiding in the planning of rehabilitation programs.




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# Chapter I

# INTRODUCTION

## LITERATURE REVIEW:

The majority of investigations suggests that left hemisphere lesions disturb performance on verbal tasks, while right-sided lesions impair tasks requiring the ability to deal with visuo-spatial relationships. Although the cerebral asymmetry of functions existing between the right and left hemispheres is not as clear-cut as once claimed, there nonetheless remains ample evidence in favor of such assymetry of cerebral organization. A review of studies comparing the performance of patients with right hemispheric (RH) and left hemispheric (LH) lesions points in this direction.

### Intellectual Abilities

The exceptional value of studies investigating the effects of craniocerebral traumata on intellectual functions lies in the existence of a relatively large number of subjects who undergo no intellectual loss in spite of severe brain injury. This demonstrates the high degree of adaptability of the human brain after



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severe traumas.

Weinstein (1962) compared the performances of veterans who were victims of gunwounds (total of 350 veterans; 232 with penetrating injuries to the brain and 118 with missile wounds of the peripheral system with no known involvement of the central nervous system) in terms of preinjury and postinjury scores on the Army General Classification Test (AGCT; presumably, an intelligence test). This test was usually given to all men upon their induction into the army. Whereas the preinjury means were practically identical (a mean of 1.4 in favor of the controls), a significant loss was noticed in patients who suffered wounding of the parietal or temporal lobes of the left hemisphere. He furthermore reported that only left parietotemporal lesions were associated with significant losses on the AGCT. The same results were obtained when aphasic cases were excluded from the analysis. It was therefore concluded that patients with lesions affecting the left parietotemporal area exhibited intellectual impairment independent of any language loss. However, it could be argued that, apart from the fact that AGCT may not assess intellectual abilities, this test may also be sensitive to changes occuring within the left parietotemporal area only.

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An extensive study on the intellectual consequences of focal missile wounding to the brain was conducted by Newcombe (1969). Studying more than 1000 men injured in W.W. II, she proceeded to study the performance of such men on various tasks. The general intellectual abjlity of right-hemisphere and left-hemisphere groups was found not to differ and no evidence of a generalized intellectual deficit after unilateral lesions was found to be caused by penetrating missiles. Similar results were obtained by Blakemore & Falconer (1967) who further argue that the initial drop in verbal IQ for the LH group and in the performance IQ for the RH group recover to preoperative levels within one year of operation. This demonstrates how very little information is provided by IQ changes concerning the effects of penetrating cranial traumas.

Language

Possibly the most researched dichotomy existing between the 2 hemispheres is that referring to the acquisition and retention of verbal material. Associations between disorders of speech and lesions of the left hemisphere were first emphasized by Dr. Marc Dax at a Congress in 1836, whose manuscript unfortunately remained unpublished. It is not until the advent of Broca's work some 30 years later that the

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predominance of the left hemisphere for speech was to be publicly acknowledged. Since that time, numerous are the researchers who have devoted efforts and time at outlining the dominance of the left hemisphere for language-related material (Newcombe, 1969; Milner, 1969; Teuber, 1974).

Milner et al. have conducted studies which bring convincing evidence to the concept of hemispheric asymmetry for language. In her studies of memory deficits after head injury, Milner (1969, 1975) claims that specific memory changes are apparent when groups of left temporal and right temporal lobectomized patients are compared. The left temporal patients are unable to remember verbal information (words and numbers) irrespective of the modality of presentation, and yet are successful at remembering nonverbal material such as faces, patterns or tunes. For their part, right temporal patients exhibit a nonverbal memory impairment and are thus characterized by a performance opposite to that of the left temporal group. Based on a different population, Bennett-Levy, Polkey & Powell's results (1980) are in agreement with such double dissociation. In contrast, Meyer & Jones (1969) have reported that, contrary to expectations, patients whose right temporal lobe is lesioned fail to score lower on non-verbal tests. They argue that the

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discrepancy in results between Milner's study and theirs may be due to larger lesions affecting the parietal region in Milner's sample.

Newcombe (1969) similarly concludes that the left hemisphere group is impaired in the learning and retention of verbal material. Furthermore, in their subjective testimony, patients with left hemispheric lesions complain of difficulty in remembering phone numbers and names of friends as well as difficulty in recalling exactly what the exact wording of a message is although the gist is easily retained. Studies excluding all cases showing any dysphasic symptoms have still given support to the double dissociation with respect to verbal and spatial tasks (Blakemore & Falconer, 1967; Micelli, Caltagirone, Gainotti, Masullo & Silveri, 1981).

Less agreement for intrahemispheric differences is reported in the literature. Thus, Milner (1969) states that frontal patients are mainly impaired on a test of word fluency while temporal patients are far worse on verbal memory tests. Newcombe (1969), in disagreement with these results reports that left head-injured patients exhibit poor performance on such tasks irrespective of the intrahemispheric locus of lesion. An additional study conducted with 82 right and 67 left head-injured patients showed that the lobe effect

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failed to reach the significance level both on verbal and visual-spatial tasks (Micell et al., 1981). Only the Word Fluency test was impaired mainly by lesions involving the frontal lobes.

A long-term study of 86 patients (54 left and 32 right hemispheric lesions) who underwent an anterior temporal lobectomy produced interesting results concerning the permanence of auditory-verbal deficits exhibited by patients whose left temporal lobes have been removed (Blakemore & Falconer, 1967). Reviewing cases where patients engage in complex language-related tasks following a dominant temporal lobectomy, (such as acquiring fluency in 2 foreign languages or the ability to recollect numbers), the authors argue against the stability of verbal deficits in such patients. Although Milner's studies seem to indicate such permanence of impairment, Blakemore & Falconer state that the presence of deficits over a 2-3-year-period falls short of proving the durability of the deficits. Submitting the patients to a battery of paired-associates learning tasks over a period ranging from 2 to 10 or more years after the initial injury, the authors demonstrate that while the LH patients are markedly deficient on an auditory-verbal learning task within 2 to 3 years postoperative, rapid improvement is observed afterwards. Indeed, the mean

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performance of this group of patients has returned to the preoperative level by the fifth postoperative year. Although their statistical analyses reveal that recovery is adversely influenced by increasing age of patient at the time of operation and by presence of epileptic fits, the results do lend support to the transient character of verbal deficits found in left temporal lobectomized patients.

Critchley (1962) has called attention to the linguistic capacities of the right hemisphere. Although right- hemispheric lesions have a minimal effect on language, Critchley points out that damage to the right hemisphere may severely affect language-related tasks and result in blocking in word-finding, inordinate delays in identification of language (auditory or visual), difficulties in learning novel linguistive material, hesitancies and inaccuracies of speech. Right frontal lesions may also have a deleterious effect upon word fluency (Miceli et al., 1981). Although such possible consequences of right hemispheric lesions may occur, the consensus remains that speech is dependent on the integrity of the left hemisphere.

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Spatial Orientation

While the right hemisphere has for a long time been associated with the learning and retention of non-verbal information (Milner, 1965; Milner, 1969; Newcombe, 1969; Miceli et al., 1981), the effects of right hemispheric lesions on spatial abilities are not as clearly lateralized as those of left hemipheric lesions with respect to language (Milner, 1975). For instance, while constructional apraxia, which refers to a failure to spatially organize the element of an assembly into a single entity (Kleist, 1934), is most often associated with right lesions (Hecaen, 1962; McFie, 1969; Newcombe, 1969) it has also been found with left lesions (Critchley, 1953) although the type of impairment is then different. Right lesions are associated with fragmented drawings where there is an obvious loss of spatial relations while left lesions lead to an executive deficit by which drawings are spatially accurate but oversimplified (Warrington, 1969 in Vynken & Bruyn, 1969).

The relatively low level of specialization of the right hemisphere with spatial tasks has been outlined by Newcombe's results (1969). Although patients with right-hemisphere damage as opposed to LH patients are impaired on visual pattern-matching, visual non-verbal

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recurring Figures Test and block design, the difference in performance falls short of significance. In contrast, visual closure and spatial orientation tests reveal a selective disability correlated with damage involving the posterior areas of the right hemisphere. Contrary to the importance given to severity of wounding by Erculei (1969) in relation with adjustment, Newcombe found this variable as well as depth of lesion to be virtually non-related to test performance.

Patients with injury to the right hemisphere are found to be deficient on tasks such as three-dimensional block construction and copying of designs (Benton, 1968), and to exhibit deficits such as inability to perform calculations, sensory disorders, disorientation of spatial information and hemiasomatognosia , spatial agnosia (Hecaen, 1969), anososognosia, dressing apraxia, and spatial neglect (Kertesz & Dobrowolski, 1981). Spatial agnosias are also reported as being specific to posterior injuries to the minor hemisphere. Hecaen (1962) reports that out of 59 cases of this type of agnosia, he found 51 instances of right hemispheric lesions, 4 cases of bilateral lesions and 4 instances of lesions to the left hemisphere. As well, disturbances of topographical relationships such as inability to orient oneself in space are principally dependent on

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parieto-occipital lesions of the right hemisphere. Hecaen reports that over 72% of cases exhibiting such disturbances were due to right hemispheric lesions.

Milner (1969) brings further evidence for an impaired performance of RH patients on spatial tasks by reviewing results of studies using the Rey-Osterrieth complex figure (Rey, 1942; Osterrieth, 1944). Once more, as a group, the right temporal patient show impaired memory on this non-verbal task when compared with the left temporal group upon delayed recall. One important aspect of the impairment exhibited by RH patients is that their spatial deficits are not solely apparent on visual tasks but have also been demonstrated on complex tactual (Weinstein, 1962) or auditory (Milner, 1962) tasks. As such, the spatial deficits exhibited by patients who undergo right craniocerebral trauma are termed material-specific, i.e. irrespective of the mode of presentation of the test material.

Finally, using a sample of 24 LH patients and 15 RH patients, Heilbrun (1969) while providing support for the superiority of RH patients on verbal measures fails to demonstrate an inferior performance for those patients on a spatial battery. Even when stricter criteria are adopted for spatial tests (i.e. exclusion of 2 spatial tests since they require verbal

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responses), no significant results are obtained. Furthermore, the exclusion of 7 patients from the LH group who exhibit dysphasic symptomatology removes the across-group significant difference obtained with respect to verbal tasks. If one accepts Milner's contention (1965) that the size of lesion in the right hemisphere may be of higher relevance than the site of injury itself, Heilbrun's negative results may be tentatively explained in terms of lesion size not large enough to produce any impairment. Unfortunately, no information that would allow a comparison of lesion size was available.

Vision

The importance of the right hemisphere for visual perception has been revealed by studies linking perceptual changes, visuospatial or visuoconstructive deficits (Teuber, 1962; Milner 1962; Weinstein, 1962) with right hemispheric lesions.

Indeed, right temporal lobe epileptics are inaccurate in pointing out incongruities in sketchy, cartoon-like drawings (Milner, 1958), deficient in recognition of overlapping nonsense figures (Kimura, 1960), as well as impaired for face recognition and delayed recall of geometric figures (1960). Bringing further evidence to the predominant role of the right

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hemisphere in visual changes are results indicating that patients with epileptogenic activity of the right occipital hemisphere experience a majority of visual seizures and hallucinations (Teuber, Battersby & Bender, 1960).

In an attempt to investigate the effects of right temporal-lobe damage on rapid visual identification, Kimura (1963) tested patients who had undergone unilateral temporal lobectomy for the removal of epileptogenic tissue. Five tachisoscopic tests were used; a Letters, Overlapping Nonsense Figures, Overlapping Familiar Figures, Dots and Familiar Objects tests. Performance was measured in terms of the number of stimuli correctly recognized. As well, a Recurring Figures test which requires the subject to say whether or not a design had been presented before was administered.

The performance of the right temporal group was significantly inferior to that of the left group on the Overlapping Nonsense Figures, Dots and Recurring Figures tests. The Letters and Overlapping Familiar Figures test failed to distinguish between the 2 temporal groups. The results obtained from an analysis where size of removal was matched for both groups indicate that the impaired performance of the right group on three of the tests could not be attributed to

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a difference in size of excision. The impaired performance of right temporal patients on tests using unfamiliar material suggests that damage to the right temporal lobe may affect one's ability to deal with novel information.

Milner (1965) investigated the learning ability of 74 epileptic patients with unilateral cortical excisions on a visually-guided maze task. All subjects were to discover what the correct path was and were required to achieve the criterion of 3 successive errorless runs. Important differences in performance with respect to locus and laterality of lesion were obtained. Right temporal, right parieto-temporo-occipital and frontal lobe groups were significantly impaired while the performance of patients belonging to parietal and left temporal lobe groups approximated that of the controls. A comparison of the right and left temporal lobe groups indicated that the right temporal group required significantly more trials to achieve criterion and made significantly more errors. The impairment exhibited by right temporal patients is consistent with Kimura's (1963) findings regarding visual, nonverbal learning deficits in patients whose right temporal lobe has been removed.

Utilizing the tests designed by Gottschaldt (1929), Teuber & Weinstein (1956) compared the

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performance of 43 controls and 64 brain-injured patients who had been divided up according to site of damage. In an effort to minimize the confounding effect of extraneous variables, statistical analyses were done repeatedly on groups with and without visual field defect and groups with and without aphasia. Results indicated that while all brain-injured groups performed worse than the controls on the Hidden-Figure task, none of the head-injured subgroups (according to lobe) differed from one another. A difference in performance across subgroups was apparent in the analyis for aphasia only, with the aphasic faring worse. The authors concluded that impairment on this task, irrespective of visual or sensory symptoms is a nonspecific sequel of penetrating head injury.

Finally, other studies have failed to find any differences in the performance of right and left hemisphere patients on a visual task. Indeed, Teuber & Mishkin's (1954) only significant results on a task requiring the subjects to make judgment of visual and postural vertical under varied conditions of body tilt, concerned the impaired performance of patients with anterior injury versus that of patients with posterior injury. No significant differences emerged between the right-hemisphere and left-hemisphere groups. Using Thurstone's Hidden Figures Test, which requires

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subjects to extract a visual shape concealed in a larger drawing, Corkin (1979) reported that such test is sensitive to the size and not to areas of left- and right-hemisphere lesions. The performance of 74 veterans of the Korean Campaign shows that the Hidden Figures Test does not detect presence of any lesion in either hemispheres 20 years after the wounding.

Audition

Milner's research was instrumental in pointing out the laterality effects in audition. Milner (1958) states that the recall of items of a short prose passage or performance on the delayed condition of the Logical Memory subtest of the Wechsler Memory Scale are disturbed by left-temporal lesions. Deficient performance of such patients was also noticed on a delayed condition of the Association Learning subtest of the Wechsler Memory Scale (Milner, 1962). Milner points out that the learning of the paired associates may not be impaired but the ability to reproduce such associations is deficient when compared to patients with epileptic foci in other areas.

On the other hand, even when a nonverbal auditory task such as the Seashore Measures of Musical Talents is used (Milner, 1962), right-temporal patients exhibit increased difficulty in discriminating on all 6

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tests although they only do significantly worse on tests of time, timbre and tonal tests. Milner points out that the size of lesion cannot account for the marked asymmetry of effect. These results indicate once more that the asymmetry of function between the left and right hemisphere is still valid in yet another mode of presentation.

Teuber (1962) reports a slightly greater impairment of binaural localization with right parietotemporal lesions than with any lesion affecting the left hemisphere. Such results are obtained in comparing the performance of 20 men with penetrating brain wounds and of 10 control subjects on a task using dichotic clicks. The presentation of the pairs of clicks, which were presented separately one to each ear, differed in 2 respects. The integrity or arrival time of clicks were varied separately so that one set of presentations was characterized by constant intensity but varied arrival time while the other set involved constant arrival time but varied intensity. It was concluded that localization of sound in space was impaired by damage to the right cerebral hemisphere.

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Somesthesis

A lot of the work done on sensory-perceptual abilities is attributable to Teuber and his research team. The performance of patients with penetrating injury to the brain was investigated using the Seguin-Goddard Formboard (Teuber & Weinstein, 1954). Thirty-five men with a penetrating head injury of various lobes and 12 controls were asked to fit 10 forms into the appropriate openings of a board. All subjects were blindfolded. The testing consisted of 3 phases; the normal condition, the rotation condition in which the board was inverted without the knowledge of the subjects (180 rotation) and the recall condition for which subjects were to draw all the forms they could remember. Error, time of completion and number of forms recalled were recorded. Subjects were classified according to an anterior-posterior dimension, lobe subdivision and laterality.

All brain-injured groups fared worse than the controls on all 3 measures of performance. The right-hemisphere group took significantly more time than the control group and all other head-injured groups with respect to the tranfer of learning from first to second run. Indeed, five of the six men with right temporal lesions demonstrated negative transfer

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in terms of increased error and time scores. Such phenomenon points to an inability to use sensory information independently of the spatial orientation of the board. Men with posterior lesions recalled significantly less forms while the frontal group performed the best of all brain-injured groups.

Weinstein (1962) further investigated the effects of right and left lesions upon tactile size discrimination. Fifty-eight brain-injured (16 bilateral; 19 right; 23 left) and 20 control patients were asked to find out of 18 cubes, the identical cube in size to a target cube hidden from sight. Patients with right hemisphere lesions committed a significantly greater mean of errors than the left- hemisphere patients or control subjects. As well, such patients were found to be more impaired on a two-point discrimination task.

Investigating hemispheric asymmetry concerning basic sensory thresholds (light pressure, two-point discrimination, point loccalization) Teuber and his colleagues (Semmes, Weinstein, Ghent & Teuber, 1960), upon comparing 88 patients with unilateral lesions presented the following threefold conclusion; i) tactile deficits of the right hand are more easily localized than those of the left hand whose responsible lesions are sometimes largely dispersed over the right

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hemisphere and in some cases, over the left hemisphere; ii) left hemispheric lesions produce sensory changes in both hands; and iii) tactile deficits of the right hand are highly correlated (i.e. the presence of a deficit on a point localization is highly correlated with deficit on a two-point discrimination and light pressure whereas such correlation between deficits is nonexistant for the left hand). Claims of differential patterns of functional representation have also been adopted by Hecaen (1962) who claims that injury to the posterior parietal region of the minor hemisphere produces disturbances of the somatognosia of the contralateral side or limb while injury to the left hemisphere produces bilateral localized or generalized somatognosic disturbances.

Social Adjustment

One of the few accounts of social adjustment can be found in the work of Walker and his team (Walker & Erculei, 1969; Erculei, 1969). Their study is particularly important since the results are based on the sample to be used in the present research. The important sample size difference (241 in Walker's studies and 52 cases in this study), possibly due to the passage of time and difficulty in tracing all veterans, is considered random. Concerning work status,

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Erculei, in his discussion of rehabilitation of head-injured men, reports that seizures, which may occur in a many as 40% of severe open head injuries of warfare patients seem to be associated with unemployment. Epileptics are less gainfully employed mainly because of physical disability although some 17% reported that mental or emotional problems were responsible for their inability to work. The unemployed man was found to participate less in social activities than a working associate. Nevertheless, despite the severity of the woundings, it was found that a "high percentage of head-injured men (returned) to work" (Erculei, 1969; p. 384). Data based on the Oxford files (Russel, 1951) have demonstrated that 81% of open head-injured men regained full employment principally in light manual or unskilled labor. Newcombe (1969) has also commented on the striking recovery made by many.

With respect to their social adjustment per se, 87% reported a normal social adjustment while only 5 % admitted a dislike for interpersonal community activities. It is interesting to note that, contrary to the widespread claim of the negative effects of seizures upon someone's life, the epilepsy and epilepsy-free groups showed little or no statistically significant difference in terms of their participation in community events.

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Aphasia alone, and no other neurological deficit, was found to influence considerably one's involvement in social activities. Despite an equal number of friends when compared to the nonaphasic patients, the aphasics engaged less in social events (42% vs 64%) and less frequently married (13% as compared to 45 %). The aphasic group was characterized by a higher percentage of men experiencing impaired potency. Finally, only 19 out of 243 (8%) were dissatisfied with their marital status.

Walker & Erculei's (1969) conclusions stress the important role of severity of wounding on the vocational and social rehabilitation of head-injured men. The more severe the craniocerebral trauma and the lower the intelligence of the victim (Erculei suggests a cut-off value of 90), the less chance the patient stands of achieving a useful rehabilitation.

Other researchers have linked head injury to psychosocial impairment as well. In his assessment of the psychosocial outcome of severe head injury, Bond (1974) noted that the duration of post-traumatic amnesia (PTA) correlates highly with the degree of social, mental and physical disability incurred. Indeed his results show that if the PTA extends over a 4-week period, a significantly higher number of patients suffer impairment in the domains of memory,

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work and leisure pursuits. Bond deplores the highly biased rehabilitation methods towards physical disabilities since as he states "weakness, spasticity and dysphasia tend to recover eventually to a variable extent but mental handicap is the cause of serious and lasting disablement " (p. 141). The loss of social contact has also been reported as being the most disabling handicap for these patients (Thomsen's, 1984).

Personality

Some of the changes associated with head injury refer to pronounced and generalized psychological deficits and personality changes (Dikmen & Reitan, 1978). Although few authors have focused their attention and efforts on this type of sequelae concerning severe craniocerebral trauma, the present review will outline in detail some of the most important studies which have contributed to an underemphasized aspect of possible consequences following head injury.

After acknowledging the difficulties in evaluating personality and emotional status, Walker & Erculei (1969) report that personality changes, irritability, depression and impaired judgment count, in a decreasing order, among the most frequently encountered

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complaints. Looking at the performance of their head-injured population, high scores on the hysteria, depression and hypochondriasis scales of the MMPI were noted. As a whole, right hemisphere damage was associated with higher scores than that of left hemisphere. Newcombe (1969) reports similar personality changes but adds loss of confidence and tenseness to her list of common complaints.

The contribution of brain damage to psychiatric disability and effect of amount of brain tissue damaged were assessed using the Oxford penetrating head injury records (Lishman, 1966). A sample of 670 head-injured patients were first classified according to 3 levels of psychiatric disability based on their functioning up to 5 years after the wounding. 'Psychiatric disability' was arbitrarily given the following definition: "Disturbance in any area of mental life as reflected by impaired intellectual function, disorder of affect, disorder of behavior, somatic complaints without demonstrable physical basis, and/or formal psychiatric illness." (p.262)

Ninety-three patients who had resettled in full-time work, had not had any complaints and for whom intellectual impairment was not found formed Group A, the 'no psychiatric disability' group. Group C, the 'severe psychiatric disability' group, included

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patients whose symptoms were marked, persistent and chronic. Group B, the 'mild psychiatric' group, was made up of the remaining 433 cases.

With the intellectual impairment taken into consideration, the results show that indeed post-traumatic psychiatric disability is significantly related to depth and extent of brain damage as well as to post-traumatic amnesia (which may be interpreted as an indirect measure of the severity of brain damage). The psychiatric symptoms most significant to such association are generalized intellectual impairment, dysphasia, apathy, euphoria and behavioral disorders.

With respect to location of brain damage, the study suggests that with increasing level of psychiatric disability, left-hemisphere involvement increases accordingly but this relationship fails to reach significance. Furthermore, the proportion of sensory, motor and visual-field defects of the right side of the body (i.e. left hemisphere) increases slightly but significantly with increasing psychiatric disability. Increases in psychiatric disability are also found to coincide with a slight increase in frontal wounds and a marked increase in temporal wounds. Lishman's conclusion argues for a possible role on the part of the left hemisphere and temporal lobe injuries in the development of post-traumatic

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psychiatric disability. It is stated that "left hemisphere lesions may carry some extra hazard where the present concept of psychiatric disability is concerned" (p. 264; Lishman, 1966).

Thomsen's (1984) 15-year follow-up study of men having suffered blunt head trauma, has shown that although physical impairment, dysarthria and memory defects remain severe in many cases, the psychosocial and emotional sequelae represent the most serious problem. Permanent changes in personality and emotion are reported in 2/3rds of his subjects, and such sequelae are most severe in cases with anterior lesions or brainstem involvement or both. Twenty percent of his sample developed post-traumatic psychoses and 63% (5 out of 8 patients) of such patients showed signs of frontal and/or temporal damage. Changes in behavior such as tiredness, lack of interests and sensitivity distress are rated as being the most serious problem for the families of such men.

Other researchers have associated right frontal damage and marked personality change (McFie, personnal communication, reported in Newcombe, 1969) as well as lesions to the anterior portion of the frontal lobes with personality changes such as indifference, euphoria and agitation or depression (McFie, 1969).

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In contrast to the literature on head injury , studies focusing on personality changes and epileptics abound. Although it could be argued with reason that results pertaining to one population may not be generalized to another, the epileptic data is considered relevant to the present study since all veterans have suffered such sequel and since, although one may not be referring to frank brain damage in the case of an epileptic patient, a cerebral dysfunction is in operation and therefore, such studies may be relevant to the population at hand.

Numerous are the authors who point to specific personality changes in patients experiencing temporal-lobe seizures (Taylor, 1977; Lindsay, Ounsted, & Richards, 1979). Bingley (1958), in his review paper, concludes that patients with left temporal lesions may exhibit a greater tendency for mental symptoms than patients showing signs of right-sided temporal activity. As well, Pritchard, Lombroso & McIntyre (1980) noted that patients experiencing left temporal lobe epilepsy demonstrate a higher level of psychopathology than right-sided epileptics although such trend does not reach statistical significance. On the other hand, several studies have not been able to relate lateralization of temporal lobe discharge to

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psychiatric disorder (Kristensen & Sindrup, 1978; Jensen & Larsen, 1979).

In a well-known study, Bear & Fedio (1977) attempted to identify the psychological features which may distinguish epileptic patients with temporal lobe foci. Eighteen behavioral traits were assessed in 27 epileptics (15 patients with a right temporal and 12 with a left temporal foci) and 12 normal controls. The traits were assessed via questionnaires filled out by the subjects themselves and by one close observer.

Although right (RT) and left temporal (LT) epileptics did not differ in overall mean scores, significant differences emerged in the profiles. The raters viewed the RT group as displaying obsessionalism, viscosity, emotionality and sadness whereas the LT patients were seen to demonstrate a greater sense of personal destiny. In general terms, the RT group was identified with emotional changes (such as anger, sadness, elation and hypermoralism) while ideational traits such as religiosity and philosophical interests were believed to be representative of the left group. This dichotomy parallels the distinction often encountered in the literature by which right temporal focus is associated with disorders of mood while LT focus is linked to thought disorders.

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The profiles derived from the epileptics and raters were different and such patient-rater disagreement was attributed to contrasting distortions characteristic of epileptic patients. The right group displayed 'denial' in contrast to the LT patients who demonstrated a 'catastrophic' overemphasis of dissocial behavior. More specifically, RT epileptics reported more elation while the LT patients described more anger, paranoia and dependence. The results of this study produce evidence in support of hemispheric asymmetry in expression of affect.

Nielsen & Kristensen (1981) conducted a study to investigate the correlation between side of epileptic activity and personality changes. The authors compared the personality profiles obtained on various personality inventories of 4 experimental groups; a left lateral, left basal, right lateral and right basal groups. The medio-basal groups fared worse than the lateral groups on all the personality inventories. Overall, patients with left temporal-lobe focus tended to endorse more negative traits and be more emotionally labile, but with respect to a schizoid paranoid personality trait, the left groups, despite a tendency to score higher, did not significantly differ from the right groups. On the other hand, patients with left-side focus scored significantly higher on traits

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of depression and emotionality. Finally, contrary to the results obtained by Bear & Fedio (1977), the authors failed to find a correlation between left focus and dependency and anger or between right focus and elation. Nielsen & Kristensen's results proved the patients with right-sided temporal locus to have the most benign psychological profile.

## Purpose

Missile wounds of the brain have proven to be an excellent source of material for the study of specific focal impairment. Consequently much knowledge has been gained regarding the effects of focal damage inflicted by high-velocity missiles over the first and second World Wars. Numerous investigators have joined efforts in an attempt to study systematically the consequences of such unfortunate historical events.

A perusal of the literature reveals extensive accounts of the sensory, motor and cognitive consequences of severe cranial traumas. The evidence weighs in favor of an assymetry of cerebral organization for the two hemispheres. However, despite the recommendations made some 45 years ago regarding the need to assess the neuropsychiatric disorders and personality impairment of such a population (Cairns,

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1942), scant attention has been paid to the emotional handicaps incurred after such traumas. Indeed, our knowledge of the physical aspect of open head injury is vast and extends far beyond our knowledge of the ability of victims of severe craniocerebral traumas to adjust and adapt in their everyday living.

The performance of such men on a variety of specialized tests has been examined, but the meaning and validity of such assessment in terms of everyday living is questionnable. Indeed Teuber (1969) has stated that "...ordinary psychometric tests are of surprisingly limited value as supplements to neurologic examinations after brain injury,...". Milner (1969) also commented on the poor value of such scores for everyday living. Five (5) patients seen at the Montreal Neurological Institute with massive lesions of the right posterior cortex did not exhibit any difficulty with the spatial tasks of the Weschler-Bellevue Intelligence Scale although one patient complained of spatial difficulties in signing his name in the proper place on a sheet of paper! Similarly, in the field of memory, researchers are becoming increasingly aware that memory processes tested in laboratory situations may be quite different from the skills actually needed for normal functioning in everyday living (Bennett-Levy & Powell, 1980;

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Neisser, 1978). Such observations highlight the need to supplement standard tests with more sensitive tasks to bring out the long-term effects of focal brain lesions.

The lack of knowledge regarding the level of adjustment of patients having suffered severe penetrating cerebral traumata has prompted this research. Although Walker & Erculei (1969) touched upon the topics of social and vocational adjustment, little was done in terms of general psychosocial adjustment or in the revealing of potentially crucial variables in the level of adjustment of the veterans. The first issue addressed was whether or not, 40 years after the fact, characteristic adjustment levels in open head-injured patients were correlated with site and laterality of cerebral involvement. An attempt was made to determine whether or not different levels of adaptive capacity could be predicted on the basis of locus of cerebral damage.

As mentioned previously, changes in personality and affect (Hermann, 1981; Hermann & Riel, 1981; Nielsen & Kristensen, 1981), sexual disturbances (Shukla, Srivastava, Katiyar, 1979) as well as psychiatric disturbances (Gibbs, 1951) specific to left temporal-lobe epileptics have been largely researched and demonstrated. While it would be ideal in this type

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of research to compare groups stratified by cerebral lobe, the present sample rendered such an approach impossible because of a limited number of patients assigned to each cerebral lobe. Therefore, patients were categorized according to an anterior-posterior dichotomy. Since the most frequent sites of epileptogenic discharge are recognized to be the uncus and hippocampus (Penfield & Jasper, 1954), and these are located in the anterior portion of the temporal lobe, it was expected that the left-anterior group - which comprised all patients with damage to a cerebral area similar in location to that involved in left temporal epilectogenic patients - would exhibit the lowest level of adjustment. Moreover, since some of the aspects important to socialization, such as language, are thought to be subserved primarily by the left cerebral hemisphere, a disruption of such systems would be expected to impair interactions with others and, consequently, interfere with adjustment process following head injury. Once it was determined whether or not specific personality and adjustment patterns exist as a parallel to highly specific neurological deficits incurred after focal missile wounds, an attempt was made to pinpoint the most contributing variables to predict differential rates of adjustment. To this end, the variables locus, side, diameter and

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depth of lesion as well as aphasia and paralysis were considered. The adjustment level was measured by the Washington Psychosocial Seizure Inventory (WPSI) and the Subjective Memory Questionnaire (SMQ).

## Hypotheses

As with findings relating highly specific neurological deficits to focal missile wounds to the brain, it was predicted that differential levels of adjustment, as measured by the WPSI and SMQ, would be obtained on the basis of locus of cerebral damage. More specifically, it was hypothesized that subjects with damage to the left-anterior region of the brain, as opposed to damage to any other cerebral area, would exhibit lower levels of adjustment 40 years after their initial injury. Furthermore, the present study intended to determine the effectiveness of locus, side, diameter and depth of lesion as well as aphasia and paralysis in predicting long-term adjustment levels.

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# Chapter II

## METHODOLOGY

### Subjects

Out of a possible sample of 122 veterans who suffered from focal missile wounding during the second World War, 52 men, with a mean age of 66 years and a range between 59 years 8 months to 77 years, 6 months, made up this sample. These men form a highly selected group; they are all male and all suffered at least one post-traumatic seizure. The severity of their wounding renders the present cases unrepresentative of civilian head injuries. For a more detailed description of this sample, see Walker & Jablon (1961) and Walker & Erculei (1969).

Four groups of veterans were compared: right anterior, right posterior, left anterior, and left posterior groups. The anterior groups contained patients who suffered damage to the frontal, pre-frontal, fronto-temporal, fronto- parietal and anterior portion of the temporal lobe, while the posterior groups were composed of cases having sustained damage to the parietal, parieto-temporal, occipital, temporo-occipital, parieto-occipital areas



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as well as to the posterior portion of the temporal area (The subdivision done according to an anterior-posterior dimension can be found in Figure 1 and the number of cases assigned to each group is represented in Table 1.)

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Insert Figure 1 and Table 1 about here

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Material

Detailed medical records of all veterans kept at the time of their stay in Cushing General Hospital (Framingham, Massachusetts) were available in the Department of Psychiatry at the Henry Ford Hospital. As well, information regarding the physical progress of each man followed up by correspondence and questionnaires filled out in 1950 and 1960 was part of each file.

The Washington Psychosocial Seizure Inventory or the Washington Psychosocial Inventory and the Subjective Memory Scale were given as part of a larger questionnaire which was designed to assess the veterans' adjustment levels. (All three scales can be found in Appendix A.)

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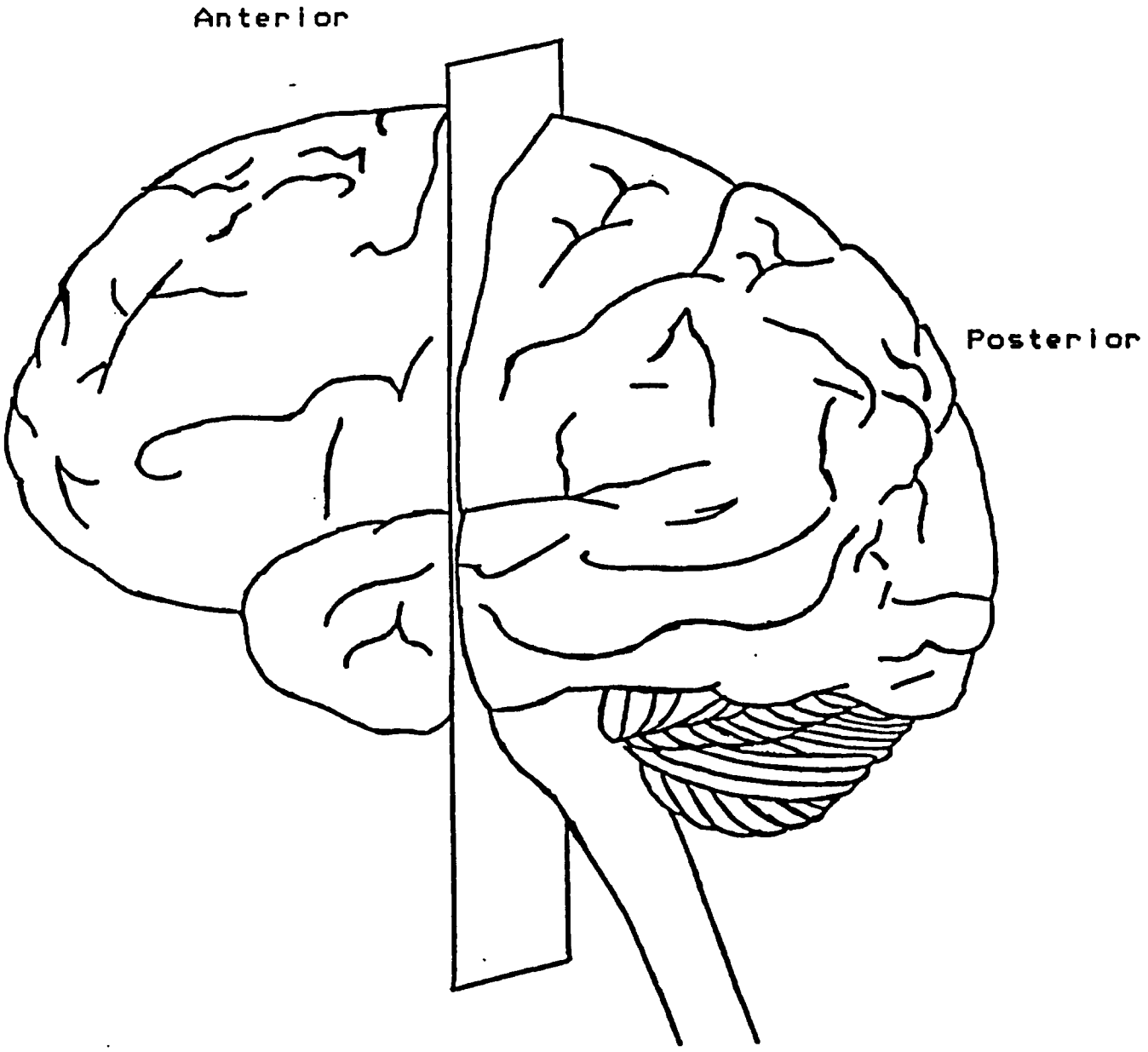


Figure 1. Subdivision of subjects according to an anterior-posterior dichotomy

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TABLE 1

Open head-injured subjects, grouped by side and locus of wounding, to whom the WPSI and SMQ were administered.

| | WPSI | SMQ |
|---|---|---|
| Left Anterior | | |
| | n=15 | n=13 |
| Frontal | 5 | 5 |
| Fronto-parietal | 5 | 3 |
| Fronto-parieto-temporal | 1 | 1 |
| Fronto-temporal | 2 | 2 |
| Anterior portion of temporal | 2 | 2 |
| Left Posterior | | |
| | n=15 | n=16 |
| Parietal | 10 | 11 |
| Parieto-occipital | 4 | 4 |
| Occipital | 1 | 1 |
| Right Anterior | | |
| | n=4 | n=6 |
| Frontal * | 3 | 4 |
| Fronto-parietal * | 1 | 2 |
| Right Posterior | | |
| | n=10 | n=12 |
| Parietal * | 5 | 8 |
| Parieto-temporal | 2 | 2 |
| Parieto-occipital | 3 | 2 |

* One veteran was found to have bilateral damage, affecting predominantly the right hemisphere. Surgical operation was performed on the right hemisphere alone.

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Washington Psychosocial Seizure Inventory (WPSI)

This 132-item inventory (Dodrill, Batzel, Queisser, & Temkin, 1980) was designed to assess the psychosocial adjustment of epileptic patients. The eight scales which make up the inventory were empirically developed and standardized on a population of 127 epileptics.

For the purpose of the present study, all scales except that concerning the Family Background were used. Questions relating to the patient's childhood events were believed to be better deleted since asking such questions over the phone was considered to be inappropriate. Thus, questions 2,12,47,54,85, 96,107,113,120 and 132 were excluded. As well, questions 3,16,110 and 127 were excluded as they focused on the possibility of future vocational advancement. It was felt that very few men in our sample would still be part of the work force. Therefore, a 118-item inventory was used as part of this study.

The other seven scales are as follows: Emotional Adjustment, Interpersonal Adjustment, Vocational Adjustment, Financial Status, Adjustment to Seizures, Medicine and Medical Management, and Overall Psychosocial Functioning (Refer to Appendix B for the profile form). In addition, the two new scales added

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by Dodrill in 1983, concerning intelligence and neuropsychological impairment, were used.

Finally, three validity scales are available: the Blank Items Scale, Lie Scale, and Rare Items Scale. Because items were deleted from the original questionnaire, the number of items required for a valid profile was changed in an effort to conserve the percentage of the total number of questions relevant for each validity scale. Therefore, it was the intention of the author to respect the 10%, 30%, and 29% cut-off points for the Blank Items Scale, Lie Scale and Rare Items Scale. However, because of the nature of the population involved, the Blank Scale was used as the only validity scale. As indicated by Dodrill, Batzel, Queisser & Temkin (1980), "severe emotional disturbance may also result in increased endorsement of rare items, and this possibility needs to be considered when other factors can be ruled out." (p. 133). It was felt that the elevated number of rare items endorsed in some cases was a result of the emotional distress following a severe head injury and not due to random responding or poor understanding. This opinion was based on clinical judgment following each interview.

The most frequently endorsed item on the Rare Scale for all groups, with a percentage of subjects

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ranging from 50% to 71%, was item 70, which refers to having needed surgery for one's medical condition. The high percentage of veterans endorsing this item is understandable, considering the nature of their injury. Only one subject gave an affirmative answer concerning Quidodzell's disease, which is in fact a non-existant medical condition, and less than 8% of all subjects admitted to using alcohol or drugs excessively. None of the subjects endorsed items having to do with wanting to harm others, hearing voices when no one is around, uncaring parents, or having often been punished without cause as a child. The remaining items dealing with one's attitudes towards doctors were minimally represented across groups, although admitting to feeling uncomfortable and disliking one's doctor increased in many cases the Rare Items Scale above the cut-off point of 4. Therefore, none of the profiles was disqualified on the basis of this scale.

With respect to the Lie Scale, the most frequently endorsed items were 17, 35, 50 and 58. A higher number of subjects with damage to the left anterior region of the brain produced profiles with Lie scores above the suggested cut-off point, although this difference was not significant. The only significant difference with respect to this scale was obtained following a *t* test comparison of those filling out the WPSI and those

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completing the WPI. Only the subjects with left anterior cerebral damage who filled out the WPI left a significantly higher number of blank items ($t$ (12) = 2.8, $p$ < .02) although their scores were still within the valid range. Two-way ANOVAs performed on all 3 validity scales revealed no significant differences between any of the groups. Because of the relative recency of this instrument and the nature of the population under investigation, only the profiles for which all three validity scales were exceeded or where a significant number of items were left blank, were excluded. Overall, 3 profiles, one from each of the left-anterior, right-anterior and right-posterior groups, were excluded on the basis of the number of blank items.

Upon completion of the inventory, each questionnaire was scored in a fashion similar to that of the MMPI, and a profile was derived for each patient. The more elevated the score, the higher the level of maladjustment on all clinical scales except that for Intelligence. It should be noted that all of Dodrill's scales are adequate for groups, but not so much for individuals. Consequently, groups were compared in terms of average profiles on the WPSI.

Dodrill et al. (1980) report an interrater reliability ranging from 0.80 for scale 7 to 0.95 for

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scale 3, and a test-retest reliability ranging from 0.66 for scale 7 to 0.87 for scale 5. Finally, the concurrent validity coefficients between the clinical scales and professional ratings, which are all significant at the 0.01 level, range from 0.56 for scale 7 to 0.75 for scale 1. For additional references on the WPSI, refer to Batzel, Dodrill, & Fraser (1980), Dodril, Breyer, Diamond, Dubinsky, & Geary (1984) and Dodrill, Beier, Kasparick, Tacke, Tacke, & Tan (1984).

Washington Psychosocial Inventory (WPI)

The Washington Psychosocial Inventory (WPI) is a variation of the WPSI in that the only changes made were the replacing of the word 'seizure' by the phrase 'medical condition'. The revision is so recent that no reliability or validity studies exist to date. However, Dodrill (personal communication, 1985) believes that the psychometric properties of the WPI will be quite similar to those of the WPSI. The WPI was given to all veterans who had not experienced any seizures in the last 20 years. Results of *t* tests carried out to determine whether or not the 2 forms of the WPSI differentially affected the results indicated no significant differences for any of the clinical scales except that of Scale 6, Adjustment to

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Seizures/Head Injury ($t$ (12) = -2.33, $p$ < .04). The left-anterior subjects filling out the WPSI (M = 5.25), thus having experienced seizures in the recent past, scored significantly higher than those filling out the WPI (M = .90). Therefore, the subjects still experiencing seizures obtained significantly higher levels of maladjustment than seizure-free left-anterior subjects on the Adjustment Scale. Consequently, with the exception of the exclusion of the left-anterior subjects answering the WPSI on the Adjustment Scale, all further statistical analyses were performed with all subjects regardless of which form of the WPSI was filled out.

Memory Scale

The Subjective Memory Questionnaire (SMQ; Bennett-Levy & Powell, 1980) was designed to measure memory functioning in daily situations. Contrary to standard laboratory tasks, this self-report measure of memory loss is geared towards pinpointing more accurately the memory deficits of an individual.

The SMQ was used in order to study the extent and nature of possible memory deficits of an open head-injured population. This 43-item questionnaire was standardized on 141 subjects. The authors have

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reported a test-retest reliability coefficient of 0.86

Each patient received an overall score for the Memory Scale based on a 5-point answer for each item. The higher the score, the better the ability to deal with the list items on a daily basis. Once again, groups of patients were compared in terms of mean performances on this measure.

## Procedure

The initial contact was made through a letter which was sent out to a total of 122 veterans for whom addresses were available. The standard letter introduced the study and explained its purpose. As well, a volunteer agreement form on which consent was sought and name of a significant other requested was included in the first letter. A response sheet was to be filled out and sent back to our research team in the self-addressed envelope provided for this purpose (See Appendix C for the letter).

Sixty interviews were conducted. However, four interviews were conducted with a significant other and, although some parts of the questionnaire could easily be answered by someone other than the veteran himself, the WPSI and the Memory Questionnaire could not.

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Therefore, these four interviews were not included in the present analysis. Two other veterans requested to have the questionnaire sent to them and, altough some information was gathered on the phone, the WPSI and Memory Questionnaire were never returned. Finally, 2 veterans to whom the entire questionnaire was administered were not included in the present study since neither man could be assigned to any of the four groups. One sustained damage to both the left frontotemporal and right frontoparietal regions, while the second man suffered from brain damage affecting the frontal, parietal and occipital areas. Thus, our final sample consisted of 52 veterans, of whom 10 received the WPSI and 42, the WPI.

Forty-one letters were returned with unknown addresses. The next resort was then to send the names and serial numbers to the Veterans' Administration (V.A.) in the hope that the V.A. would have a more recent record of addresses. Since most of the men are likely to receive a pension, it was felt that their names would be on the V.A. records. As can be expected, this way of tracing people is very time-consuming and unfortunately, to date, no positive results have been obtained.

Three letters were returned because the veterans had died and eight refused to participate. This

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extremely low rate of refusal -less than 7%- is believed to be entirely due to the excessive gratitude and respect held by the majority of the veterans toward Dr. Walker for his treatment and continued kindness over the years (each of the veterans has had annual contact with Dr. Walker through Christmas cards). All contributions by the veterans were made on a voluntary basis and none of the interviewed men gained benefit from this study except the knowledge of providing important information for the sake of research.

Once agreement was obtained either via the consent form or by phone, an interview time convenient to the veteran was arranged. All phone interviews were tape-recorded and lasted a mean time of 69.9 minutes, with all interviews ranging from 35 to 120 minutes. Although the majority of interviews were conducted in approximately one hour, cases where a significant other had to assist the veteran for reasons of expressive difficulties or hearing impairment, took longer. Shorter interviews were also conducted depending on the social status of the veteran. A single man would not be subjected to some parts of the comprehensive questionnaire dealing with marital matters. As well, some changes were made when judged necessary due to the condition of the veteran. For instance, in cases of extreme fatigability, the interview was conducted over

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2 sessions or part of the questionnaire was sent by mail.

Prior to all interviews, each medical file was coded for the information already available (i.e., details of wounding, 5-year and 15-year follow-up studies) so as to ensure that the interviewer was familiar with each case before conducting the phone interview. It was decided that such an approach would prove valuable in the establishment of rapport with the veteran and would prevent embarrassing and inappropriate questions because of unfamiliariaty with the case.

After the interview, a letter thanking both the veteran and the significant other for their participation and time was sent. Since some parts of the comprehensive questionnaire were sent by mail, directions on how to answer those were also given (see the standard letter in Appendix D).

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# Chapter III

# RESULTS

## Data Analysis

Once all the information was collected on a veteran, the data were analyzed with Statistical Analysis System computer subprograms. For several reasons, be it the inability of the veteran to express himself clearly enough or the limited cooperation of the veteran, not all questions were answered by all men. Therefore, the number of subjects included in different statistical analysis varies.

In order to test the overall side by locus interaction as well as the main effects of side and locus of injury on levels of adjustment, fixed two-way multiple analyses of variance using the Hotelling-Lawley's trace criterion were performed on the WPSI, with side and locus of lesion as the independent variables and the remaining nine scales of either form of the WPSI as the dependent measures of adjustment. Subsequently, a series of separate two-way analyses of variance were carried out for each adjustment measure and for the SMQ, with side and locus



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of lesion as the two independent variables. The Newman-Keuls procedure was used in all cases of significant results from ANOVAs in order to determine which groups were statistically different from one another.

A stepwise multiple regression (MR) analysis to investigate the relative predictability of differential levels of psychosocial adjustment was carried out. Although the variables to be included differed in nature, it was felt that MR could still be carried out using a dummy variable coding. According to a classic paper by Cohen (1968), multiple regression analysis is the model of choice when nominal, ordinal, or interval independent variables are to be used concomittantly. The following variables were entered into the statistical analyses:

1. Locus of lesion (anterior, posterior)
2. Side of lesion (left or right)
3. Aphasia (presence or absence)
4. Paralysis (absence, partial, hemiparesis, total)
5. IQ as measured by the Wechsler-Bellevue Intelligence Scale in 1959-1960.
6. Diameter of lesion (four sizes in centimeters)
7. Depth of lesion (four levels from cranial to ventricles)

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WPSI Results

In order to facilitate comparison of groups across scales, the average performance of each group is presented in Figures 2, 3 and 4. The numbers on the right side of the profile in Figure 1 indicate the ranges of profile elevation.

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Insert Figures 2,3 and 4 about here

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In order to determine the effects of severe craniocerebral trauma on long-term adjustment level, a 2-way MANOVA was performed on the WPSI. This analysis yielded significant results for the overall side by locus interaction ($F$ (7,31) = 2.61, $p$ < 0.03) as indicated bythe Hotelling-Lawley's Trace criterion. The main effects of side ($F$ (7,31) = 1.32, $p$ < 0.27) and locus of lesion ($F$ (7,31) = 0.91, $p$ < 0.51) however failed to reach statistical significance.

In order to assess the relationships between side and locus of lesion on each of the WPSI scales, two-way ANOVA's were conducted. Table 2 presents the means used for these analyses. Significant main effects for

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Insert Table 2 about here

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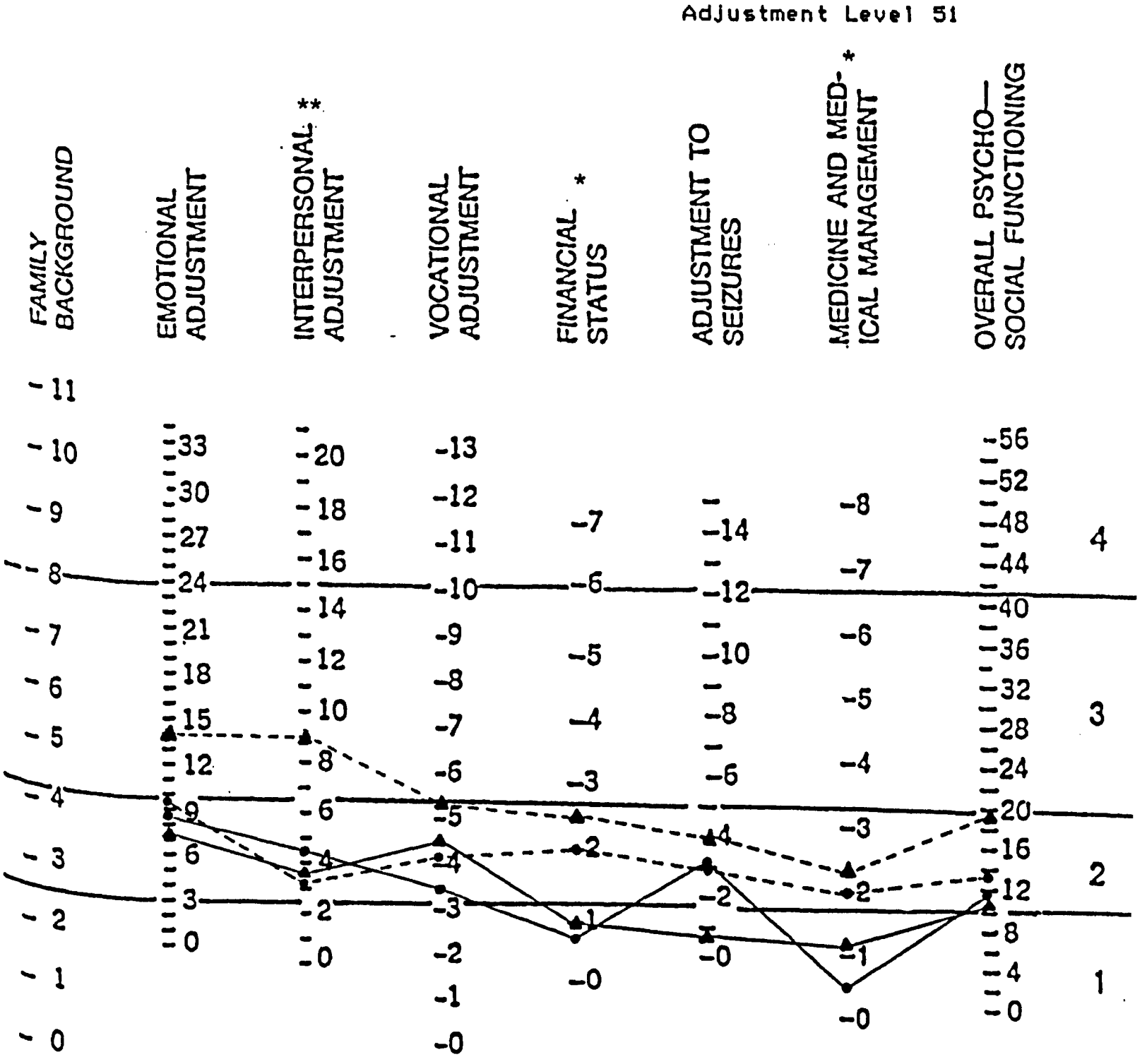


Figure 2. Average Washington Psychosocial Seizure Inventory profiles for all four groups.

▲——▲ = Left Anterior group
●——● = Left Posterior group
▲- - -▲ = Right Anterior group
●- - -● = Right Posterior group

* significant main effect for side of lesion
** significant side x locus interaction

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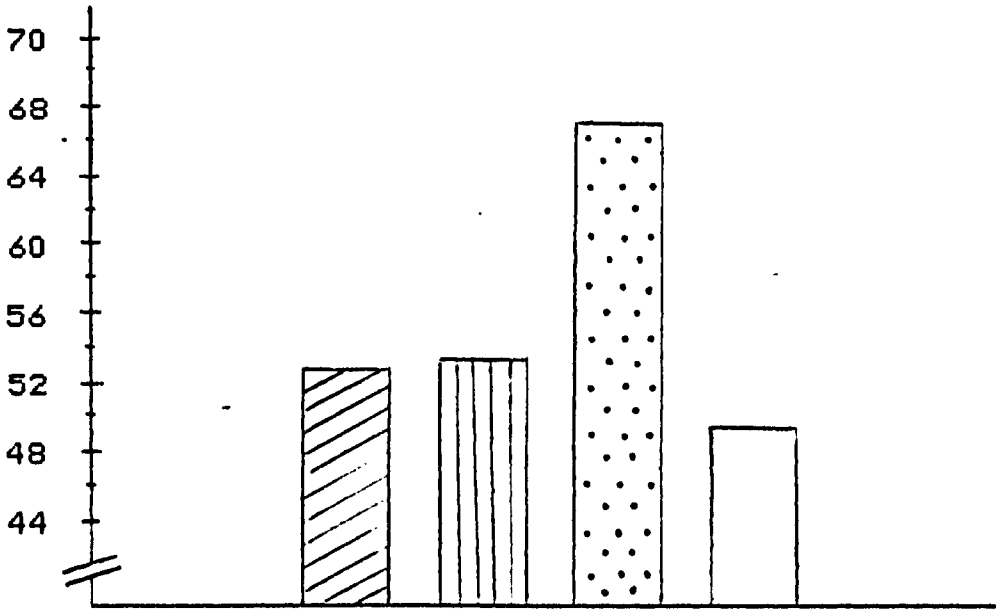


Figure 3. Mean scores for all groups on the Neuropsychological Impairment Scale.

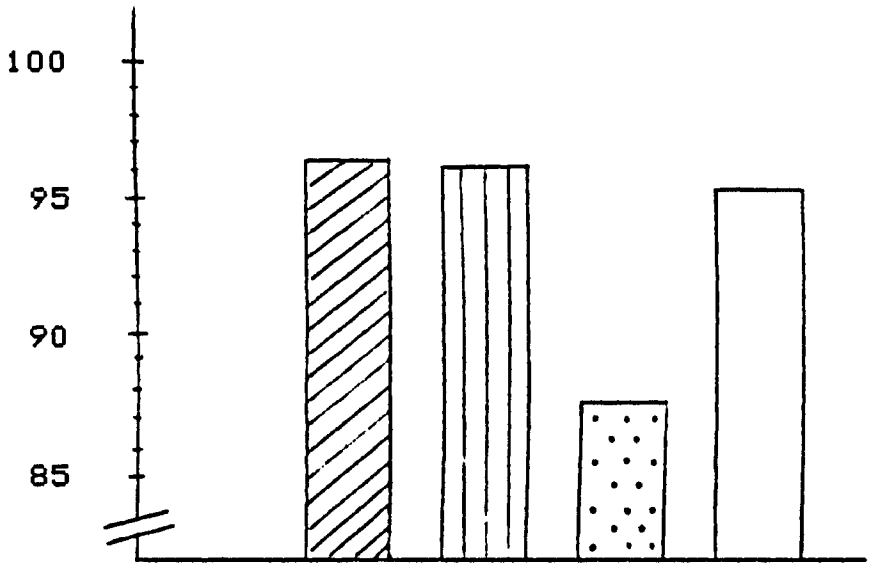


Figure 4. Mean scores for all groups on the Intelligence Scale.

= Left Anterior group
= Left Posterior group
= Right Anterior group
= Right Posterior group

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TABLE 2

Side and locus of injury mean score comparisons among WPSI scales and SMQ.

| | LEFT | RIGHT | ANTERIOR | POSTERIOR |
|---|---|---|---|---|
| | N=41 | | N=41 | |
| WPSI (N=41) | n=29 | n=12 | n=17 | n=24 |
| Emotional Adjustment | 7.90 | 10.67 | 8.29 | 9.00 |
| Interpersonal Adjustment | 4.62 | 4.75 | 4.65 | 4.67 |
| Vocational Adjustment | 3.93 | 4.42 | 4.65 | 3.67 |
| Financial Status | 0.90 * | 2.17 | 1.29 | 1.25 |
| Adjustment to Seizures (Without significantly different scores) | 2.66 (2.24) | 3.25 | 2.47 (1.61) | 3.08 (3.08) |
| Medicine and Medical Management | 0.79 * | 2.08 | 1.29 | 1.08 |
| Overall Psychosocial Functioning | 11.31 | 15.00 | 12.29 | 12.46 |
| Neuropsychological Impairment | 53.10 | 53.92 | 55.18 | 52.04 |
| Intelligence | 97 | 94 | 95 | 96 |

| | N=47 | | N=47 | |
|---|---|---|---|---|
| SMQ (N=47) | n=29 | n=18 | n=19 | n=28 |
| | 103.55 | 102.06 | 110.11 | 98.14 |

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the side of lesion were found only on the Financial Status Scale ($F$ (3,37) = 5.27, $p$ < 0.03) and the Medicine and Medical Management ($F$ (3,37) = 4.67, $p$ < 0.04). On these two scales, patients with damage involving the right hemisphere obtained higher scores than those with left-hemispheric damage. As presented in Figures 5, 6 and 7, the right-hemispheric group obtained higher, although non-significant, mean scores on all other WPSI scales which suggest a higher level of psychosocial impairment. Consistent with previous

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Insert Figures 5,6 and 7 about here

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findings which linked higher maladjustment levels to lower intelligence (Dodrill, 1983), the right hemispheric group obtained a lower Intelligence index than the left hemispheric group.

All the main effects for locus of lesion were statistically non-significant. As illustrated in Figures 8, 9 and 10, no trend for increased maladjustment for a specific group was obtained.

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Insert Figures 8,9 and 10 about here

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The score means for each of the WPSI scales are

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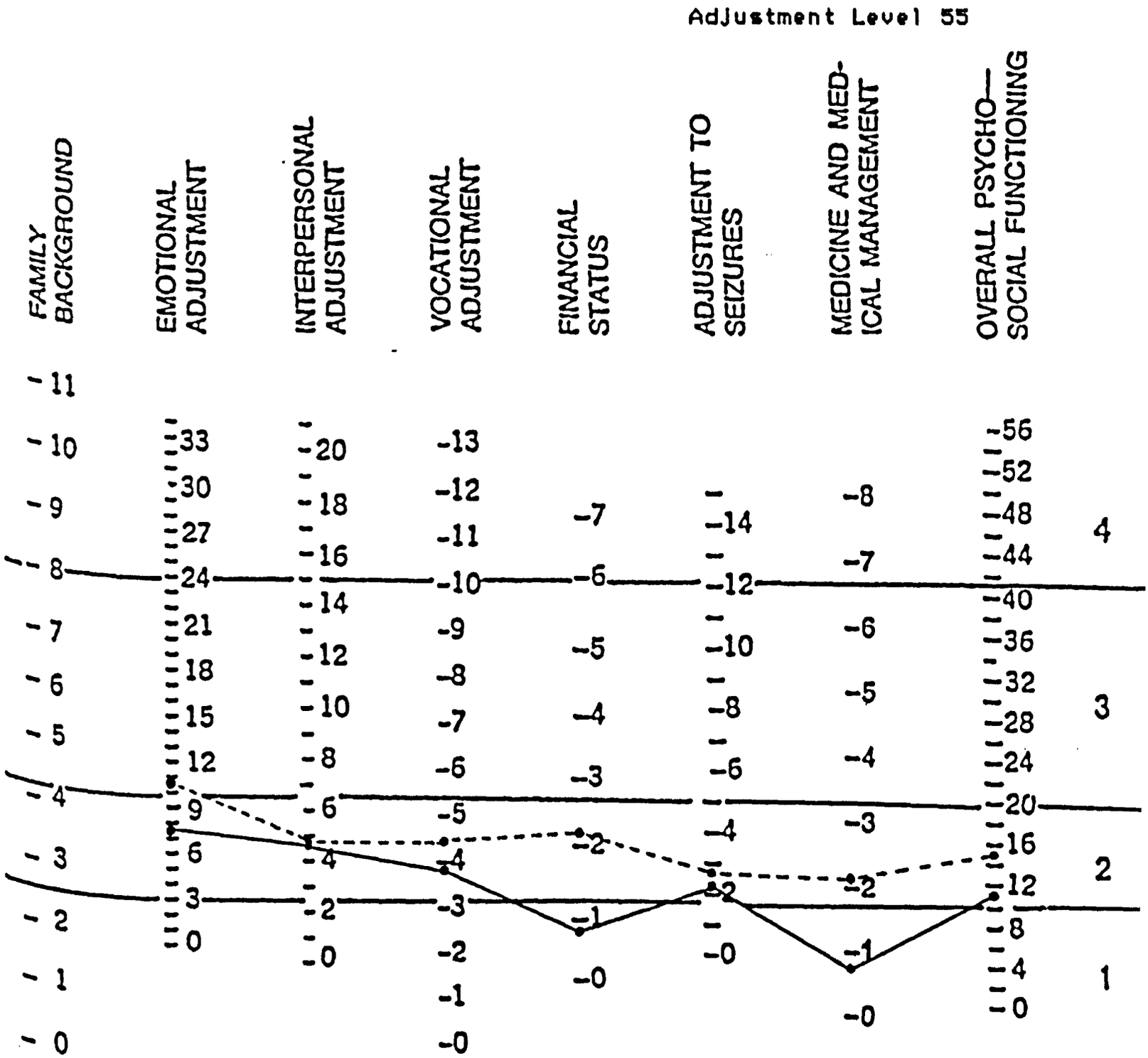


Figure 5. Average Washington Psychosocial Seizure Inventory profiles of the right and left groups.

●——● = Left Hemisphere Damage
●- - -● = Right Hemisphere Damage

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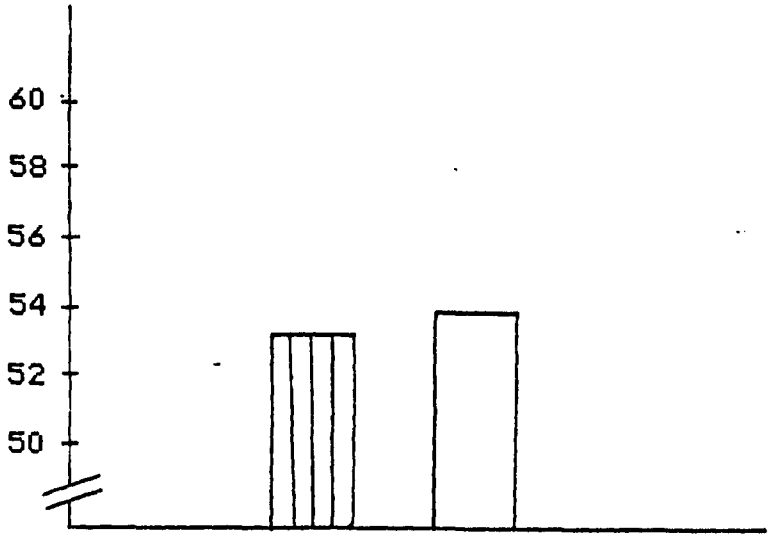


Figure 6. Mean Scores for Left and Right groups on the Neuropsychological Impairment Scale.

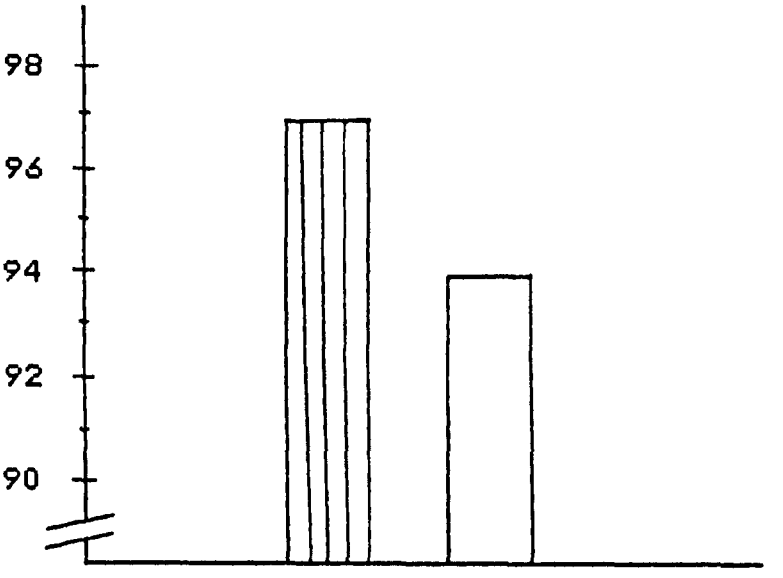


Figure 7. Mean scores for Left and Right groups on the Intelligence Scale

▥ = Left Hemisphere Damage
▭ = Right Hemisphere Damage

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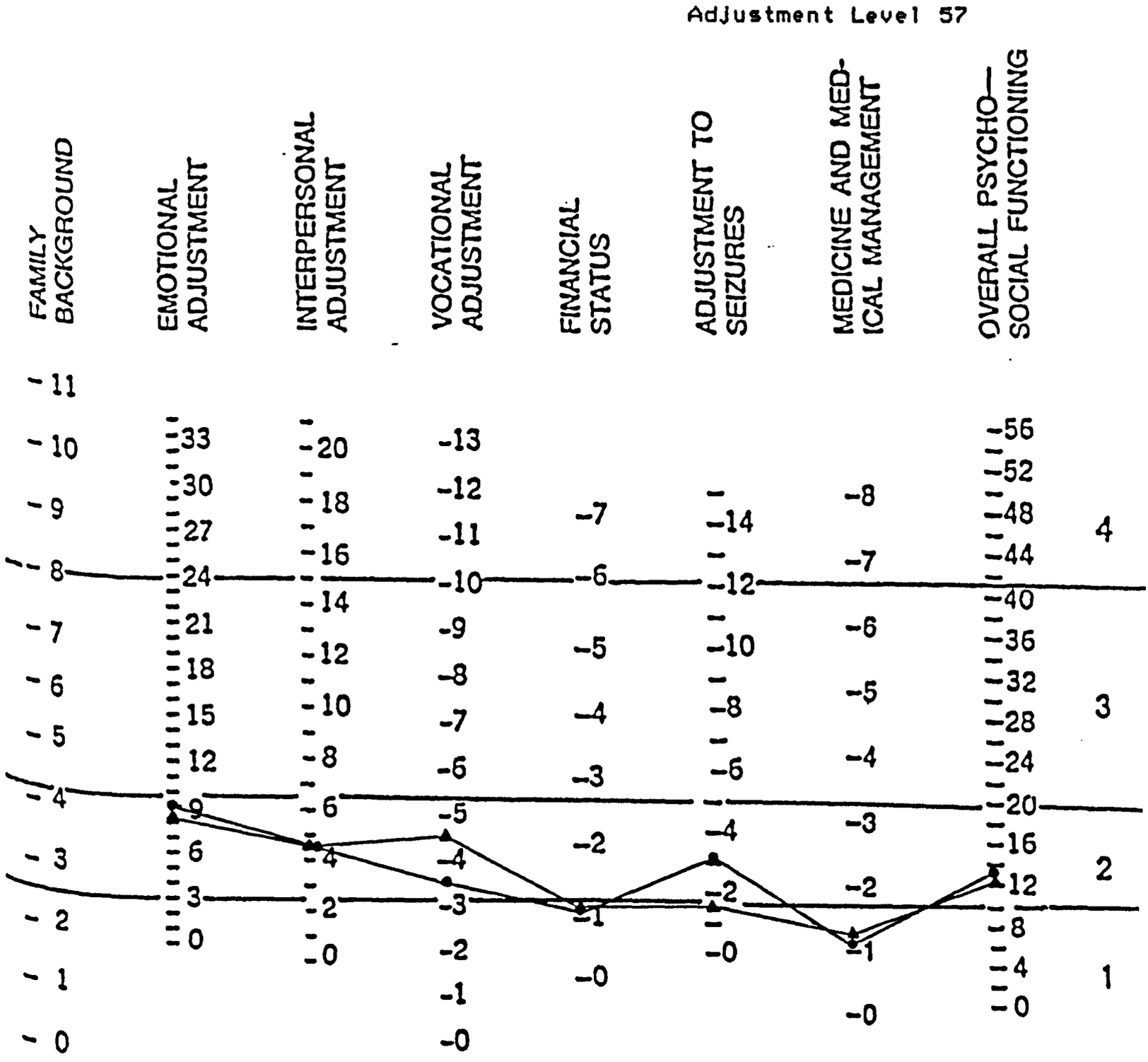


Figure 8. Average Washington Psychosocial Seizure Inventory profiles for the anterior and posterior groups.

▲——▲ = Anterior Damage
●——● = Posterior Damage

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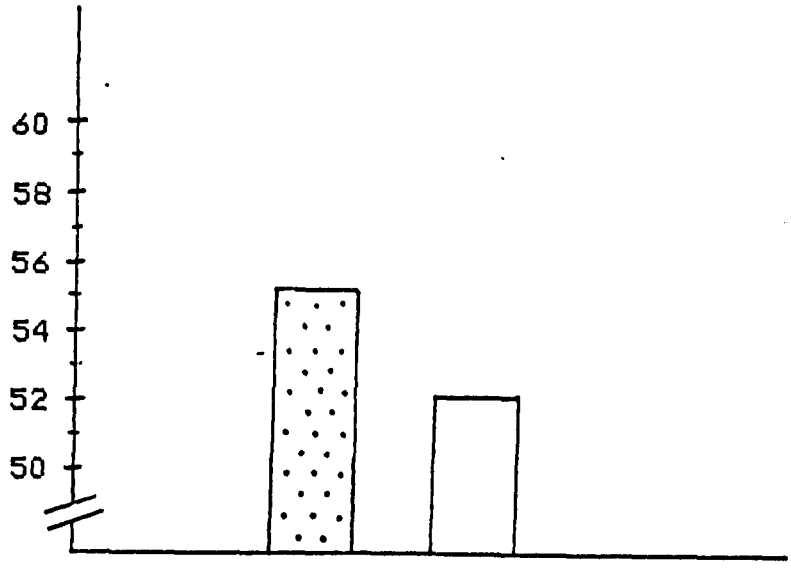


Figure 9. Mean scores of Anterior and Posterior groups on the Neuropsychological Impairment Scale.

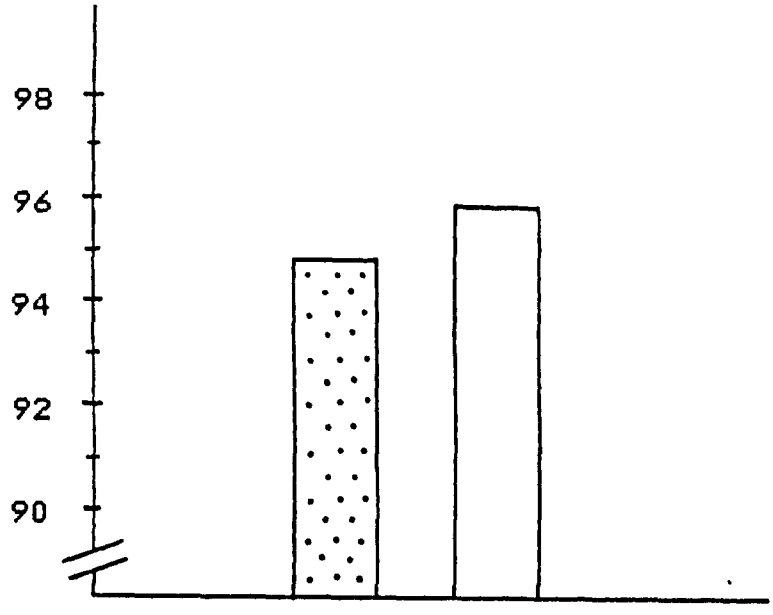


Fig. 10. Mean scores of Anterior and Posterior groups on the Intelligence Scale.

= Anterior Damage
= Posterior Damage

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presented in Table 3. A significant side by locus

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Insert Table 3 about here

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interaction was obtained on the Interpersonal Adjustment Scale only ($F$ (3,37) = 8.51, $p$ < 0.006) and is illustrated in Figure 11. The simple effects of

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Insert Figure 11 about here

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this interaction were assessed using the Newman-Keuls test. The results indicated that the Interpersonal Adjustment Scale interaction showed significant differences between the right-anterior and left-anterior groups as well as between the right-anterior and right-posterior groups ($p$ < .05). A side by locus interaction only approached significance on the Neuropsychological Impairment Scale ($F$ (3,37) = 3.67, $p$ < 0.06) and remained non-significant on all other scales.

Table 4 presents the percentages of cases with the highest scores (the greatest psychosocial difficulties) on all scales. Emotional problems were the greatest

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Insert Table 4 about here

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TABLE 3

SMQ and WPSI raw score means by cell used in MANOVA and ANOVA procedures.

| | Left-Ant. n=14 | Lt-Post. n=15 | Right-Ant. n=3 | Rt-Post. n=9 |
|---|---|---|---|---|
| Emotional Adjustment | 7.07 | 8.67 | 14.00 | 9.55 |
| Interpersonal * Adjustment | 3.71 | 5.47 | 9.00 | 3.33 |
| Vocational Adjustment | 4.50 | 3.40 | 5.33 | 4.11 |
| Financial Status | 1.0 | 0.80 | 2.67 | 2.00 |
| Adjustment to Seizures/Head Injury (Without significantly different scores) | 2.14 (0.90) | 3.13 | 4.00 | 3.00 |
| Medicine and Medical Management | 1.07 | 0.53 | 2.33 | 2.00 |
| Overall Psycho-social Function-ing | 10.71 | 11.87 | 19.67 | 13.44 |
| Neuropsychologi-cal Impairment | 52.50 | 53.67 | 67.67 | 49.33 |
| Intelligence | 96.64 | 96.47 | 87.67 | 95.67 |
| Blank Items | 13.93 | 14.13 | 15.33 | 12.00 |
| Lie Scale | 5.0 | 3.47 | 3.33 | 3.55 |
| Rare Items | 3.64 | 2.33 | 3.33 | 2.33 |
| | n=13 | n=16 | n=6 | n=12 |
| SMQ * | 114.69 | 94.50 | 100.17 | 103.00 |

* $p < .01$ for side x locus interaction

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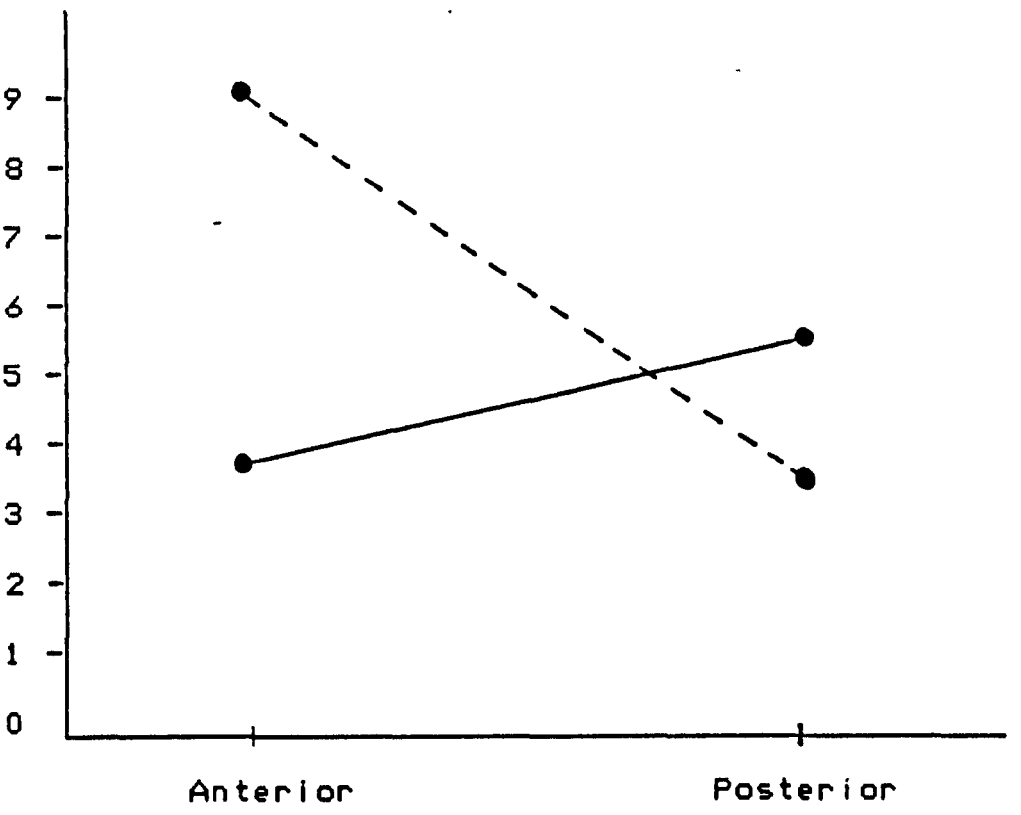


Figure 11. Interaction between Side and Locus of lesion for the Interpersonal Adjustment Scale.

_____: Left Hemisphere Damage
_ _ _ _: Right Hemisphere Damage

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TABLE 4

Percentage of cases with highest profile elevations on each scale.

| Scale | Left-Ant. n=14 | Lt-Post. n=15 | Right-Ant. n=3 | Rt-Post. n=9 |
|---|---|---|---|---|
| Emotional Adjustment | 50% | 27% | 20% | 9% |
| Interpersonal Adjustment | 14% | 22% | 0% | 9% |
| Vocational Adjustment | 29% | 17% | 20% | 18% |
| Financial Status | 0% | 0% | 0% | 27% |
| Adjustment to Seizures/ Head Injury | 7% | 17% | 20% | 0% |
| Medicine and Medical Management | 0% | 0% | 0% | 9% |
| Overall Psychosocial Functioning | 0% | 0% | 0% | 0% |
| Missing Values | 0% | 17% | 40% | 27% |

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concern for the left-anterior and left-posterior groups while the right-posterior group was most concerned with financial matters. The right-anterior group was characterized by an equal concern over emotional, vocational and adjustment matters. The area of minimum concern for all groups was that pertaining to medical management.

Table 5 illustrates the percentages of cases with the number of scales falling in the problem ranges.

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Insert Table 5 about here

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The majority of patients with damage to the left-anterior, left-posterior and right-posterior cerebral areas showed maladjustment in 2 areas or less. The right-anterior group showed difficulties on at least 3 scales.

Finally, the percentages of subjects falling in each of the profile elevation areas on the Overall Psychosocial Functioning Scale can be found in Table 6.

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Insert Table 6 about here

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The largest number of people falling in the highest profile elevation had sustained damage to the

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TABLE 5

Percentage of cases showing definite or severe problems (areas 3 and 4 on professional rating) on overall profile regardless of combination of scales.

| No. of WPSI scales in definite or severe range. | Left-Ant. n=14 | Lt-Post. n=15 | Right-Ant. n=3 | Rt-Post. n=9 |
|---|---|---|---|---|
| 0 | 50% | 26.7% | 0% | 50% |
| 1 | 21.4% | 33% | 0% | 0% |
| 2 | 14.3% | 7% | 0% | 12.5% |
| 3 | 7.1% | 26.7% | 33.3% | 0% |
| 4 | 0% | 0% | 33.3% | 0% |
| 5 | 0% | 0% | 0% | 25% |
| 6 | 0% | 7% | 0 | 0% |
| 7 | 7.1% | 0% | 33.3% | 12.5% |

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TABLE 6

Percentage of cases in each group with scores in each area of profile elevation on the Overall Psychosocial Functioning Scale.

| Area of Profile Elevation | Left-Ant. n=14 | Lt-Post. n=15 | Right-Ant. n=3 | Rt-Post. n=9 |
|---|---|---|---|---|
| Area 1: No Problems Detected | 50% | 27.8% | 0% | 36.4% |
| Area 2: Possible Problems | 35.7% | 44.4% | 20% | 9% |
| Area 3: Definite Problems | 14.3% | 11.1% | 40% | 27.3% |
| Area 4: Severe Problems | 0% | 0% | 0% | 0% |
| Missing Values | 0% | 16.7% | 40.% | 27.3% |

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right-anterior region of the brain. All other groups had an Overall Psychosocial Functioning Scale in the areas of possible problems or no problems at all. The left-anterior (50%) and right-posterior (36.4%) groups had the highest percentage of people falling in the No-problem area, while the majority of patients with damage involving the left-posterior quadrant of the brain fell in the Possible-problems area. (44.4%)

SMQ Results

To assess the effects of severe penetrating injury to the brain on everyday living closely linked to one's memory, a 2-way ANOVA was conducted with side and locus of lesion as the independent variables. The means used for this analysis can be found in Table 2. The main effects of side ($F$ (3,43) =.34, $p$ < .57) as well as main effects of locus of lesion ($F$ (3,43) = 2.79, $p$ < .10) did not reach statistical significance.

The score means for each group can be found in Table 3. A significant side by locus interaction was obtained ($F$ (3,43) = 4.90, $p$ < .03) and is illustrated in Figure 12. The Newman-Keuls procedure

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Insert Figure 12 about here

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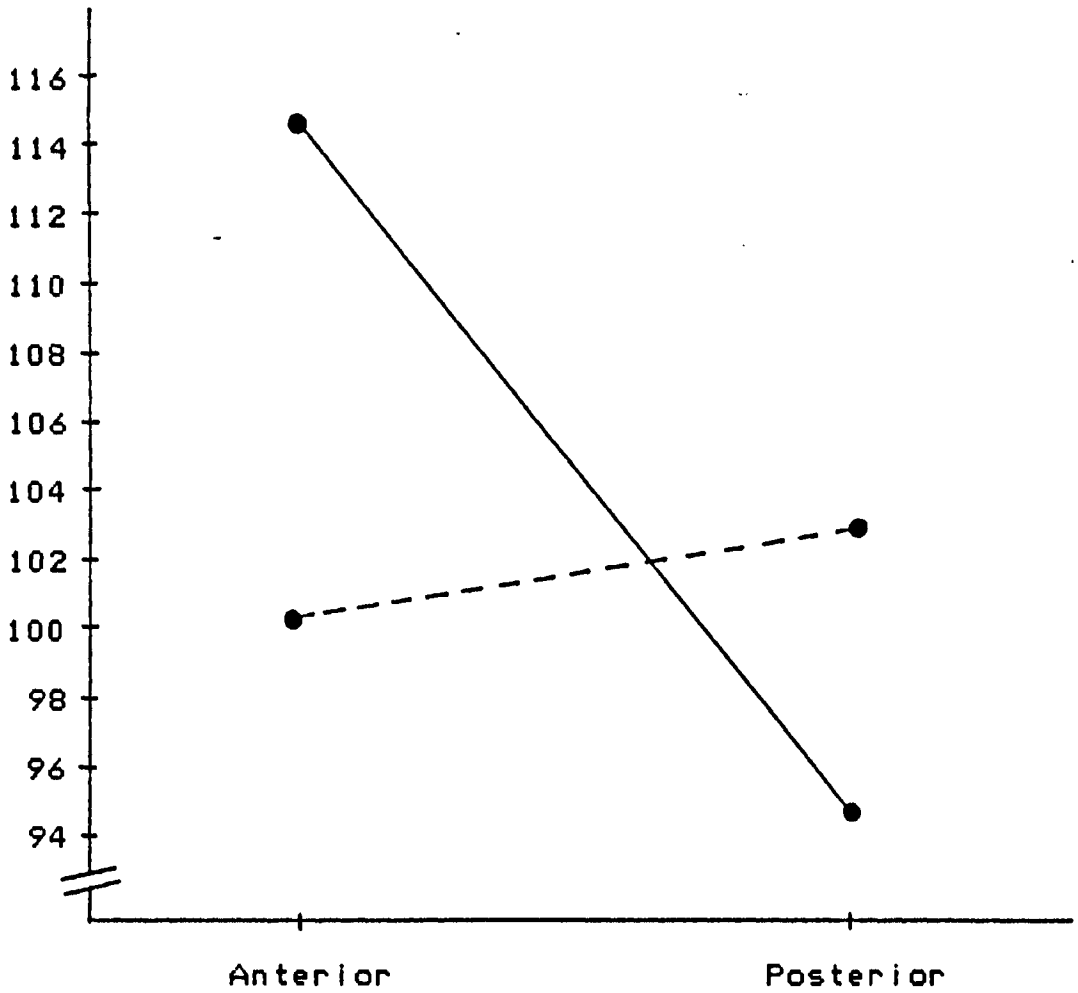


Figure 12. Interaction between Side and Locus of lesion on the Subjective Memory Questionnaire.

_____ = Left Hemisphere Damage
_ _ _ _ = Right Hemisphere Damage

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used to test the simple effects of this interaction, indicated that the left-anterior (M = 114.69) and left-posterior (M = 94.50) groups significantly differed from one another, with the left-anterior subjects obtaining a better index of daily living closely associated with memory.

Multiple Regression

The significant results obtained from the multiple regression analysis for the WPSI have been summarized in Table 7. Diameter and side of lesion count among

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Insert Table 7 about here

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the best predictors for at least 4 WPSI scales, each with p values ranging from .006 to .03. Depth of lesion and paralysis significantly predict the maladjustment levels on 3 different scales each at least at the .05 significance level. No other variables were found to be of relevance in predicting differential levels of psychosocial difficulties. The percentage of variance explained suggests that, of all the WPSI scales, the Overall Psychosocial Functioning Scale can best be predicted by the given variables with 50% of the variance accounted for. Following in terms

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TABLE 7

Summary Table of significant Multiple Regression coefficients.

| Scale | Predictor | Df | F Value | p | % of Variance Explained (Total %) |
|---|---|---|---|---|---|
| Emotional Adjustment | Depth | 1,27 | 6.61 | .02 | 19.7% |
| | Side | 1,27 | 5.79 | .02 | 14.6% (34%) |
| Interpersonal Adjustment | Diameter | 1,27 | 6.14 | .02 | 18.5% |
| Vocational Adjustment | Paralysis | 1,27 | 4.33 | .05 | 13.8% |
| Financial Status | Diameter | 1,27 | 8.97 | .006 | 22% |
| | Side | 1,27 | 4.97 | .03 | 15% (37%) |
| Adjustment Seizures/ Head Injury | Paralysis | 1,25 | 6.38 | .02 | 20.3% |
| | Diameter | 1,25 | 5.30 | .03 | 14.4% (35%) |
| Medicine and Medical Management | Side | 1,27 | 9.07 | .006 | 25% |
| | Depth | 1,27 | 4.31 | .05 | 11% (36%) |
| Overall Psychosocial Functioning | Depth | 1,27 | 7.86 | .009 | 22% |
| | Side | 1,27 | 6.55 | .02 | 16% (38%) |
| | Diameter | 1,27 | 6.16 | .02 | 12% (50%) |
| Neuropsych. Impairment | Paralysis | 1,27 | 4.62 | .04 | 15% |
| SMQ | Aphasia | 1,31 | 12.16 | .002 | 28% |

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of percentage of variance predicted are the Financial, Medical, and Adjustment to Seizure Scales. As can be inferred from Table 7, all scales but that of Intelligence can be predicted from at least one of the variables entered in the multiple regression analysis.

Aphasia was found to be the only predictor on the SMQ ($p < .002$), explaining 28% of the variance. All other variables failed to reach significance on this measure.

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# Chapter IV

## DISCUSSION

The present results suggest a differential impact of left and right hemispheric damage, although not in the hypothesized direction. Indeed, differential levels of adjustment can be predicted on the basis of locus of damage, with the right groups faring worse than groups of subjects with damage to the left hemisphere. These results, although in disagreement with the epileptic literature are concordant with Walker & Erculei's (1969) previous findings which suggested that right hemispheric lesions were associated, moreso than left hemispheric damage, with elevated scores on the MMPI. This replication of findings is especially interesting as it provides a cross-validation of results pertaining to one given population using different instruments.

Contrary to the expectations formulated on the basis of the epileptic literature, the left-anterior group always obtained the lowest or second lowest index of maladjustment on all but one scale of the WPSI and on the SMQ. The left-posterior group fared worse on this last measure, which is consistent with the involvement of the language processing systems and the



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fact that most items of the SMQ have to do with language-related information.

Before discussing the specific results obtained in this study, several factors need to be mentioned. An important bias that may confound the results is that all the veterans who agreed to participate in this study were obviously functioning well enough to go through a one-hour phone interview. Those who have been living in nursing homes for years or who have been unable to function independently since the time of their wounding would be unlikely to want to or be able to participate in such a study. It is suspected that some of the men who did not reply may have failed to do so because of disabilities preventing them from being interviewed. Therefore, as a word of caution, these results may not be generalized to the entire open head-injured population, but may in fact apply to a sample comprised of men participating in an interview.

Another factor worth addressing is the unknown premorbid functioning of this sample. As indicated by Lishman (1966), the "...stress of injury may have done no more than canalyze or liberate other latent conflicts which bear more directly on the mental picture which results." (p. 261). In other words, the

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lack of information concerning the premorbid personality and psychosocial adjustment of these men makes the task of attributing the current psychosocial difficulties to the sole effect of head injury difficult, if not impossible.

An additional bias became obvious during the interviews. Throughout the conversations, it became evident that some of the men might have been hesitant to give some information due to a fear of losing their V.A. privileges. Although this was more obvious when the section on financial matters was covered, during which some did indeed express the concern of possibly losing their pension or disability compensation were they to admit to few difficulties, it should be kept in mind that this fear may have influenced the willingness of some of the men to endorse some of the items. Closely related to this problem are the biases inherent to self-report measures which may influence the accuracy of the information given.

Two final factors worth commenting on are the advanced age and small size of this sample. It is possible, as reported by Campbell, Converge, & Rodgers (1976), that many men may report rising levels of life satisfaction with increasing age. Such a bias would

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tinge the veterans' true perception of how they were functioning in their younger years. Finally, the limited size of the sample should render one cautious as to possible related artifacts. Although the right-anterior group is indeed very small, its size seems to be reflective of this type of population, since a file study conducted with this same population where patients could be carefully selected on the basis of their locus of damage (Brandys, 1984) failed to produce a larger right-anterior group.

Right and Left Hemispheric Damage

Overall, emotional, interpersonal, and adjustment concerns were most often reported across groups. Medical management was the area of minimum concern for all groups. Contrary to expectations, the right-anterior group obtained on all scales of the WPSI the largest scores and obtained the second worse score on the SMQ. This group also showed difficulty on at least three scales (see Table 5) and was represented by the largest number of people falling in the highest profile elevations for the Overall Psychosocial Functioning Scale. These subjects obtained a higher, though statistically non-significant, neuropsychological impairment index. However, their

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score still remained within the very mild to mildly impaired range. These veterans also obtained the lowest average IQ, followed by the right-posterior, left-posterior, and left-anterior groups. In fact, contrary to the hypothesis, the left-anterior group was characterized by the highest mean IQ.

As pointed out earlier, the right groups always obtained a higher psychosocial maladjustment index than did the left groups. The fact that the right groups scored worse on all scales (WPSI and SMQ) deserves investigation. Four possible factors may explain the present results.

The first refers to the reported inability of right-hemispheric patients to pick up on social cues due to problems in processing visual-spatial information. Inappropriate behaviors and comments resulting from an inability to adequately interpret people's facial expressions, feelings, and emotions may cause peer conflicts and therefore result in the ostracism of the patient. This explanation has received partial support from Finlayson's (1974) study which explored the relationships between lesion, lateralization, and emotional reactions of patients with cerebral-vascular disease. He concluded that

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right-lesioned patients displayed more impaired social judgment than a control group and a left-lesioned group, although the results were not significant with respect to the left group. Nevertheless, Finlayson claims that there are good reasons to conclude that the occurence of differential emotional reactions is dependent upon laterality of lesion although the nature of his population may be responsible for the results obtained.

An issue related to this first factor is that the obvious aphasic symptoms of the left-hemispheric patients are likely to favor a greater understanding of the veterans' status on the part of community and family members. A better comprehension of the veterans' disabilities is, in turn, likely to compensate for some of the detrimental effects that aphasia may otherwise have on social interactions. Unfortunately for patients with right-hemispheric lesions, the subtlety of their problem makes it difficult for peers to understand the nature of their handicap, and therefore their poor social skills may not be as easily accepted as that of the left-lesioned patients.

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An additional factor possibly related to the results under scrutiny is the inability of right-hemispheric patients to adapt to novel or complex situations. Goldberg & Costa's (1981) model, which stresses the crucial role of the right hemisphere for situations that are associated with task novelty, is especially helpful at this point in explaining the difficulty experienced by right-hemispheric patients in novel situations. In turn, this inability to so adapt is likely to lead to frustration, low self-esteem and emotional distress which may well, in the long run, translate into low adjustment levels and higher incidence of psychosocial difficulties. These first two reasons are consistent with right hemispheric involvement, and similar results have been reported elsewhere (Rourke, Young, Strang, & Russell, 1986).

Yet another factor related to the overall lower level of adjustment for the right groups may possibly have to do with the severity of wounding. Two-way ANOVAs carried out on both diameter and depth of lesion revealed significant main effects of side of lesion for diameter ($F$ (3,44) = 4.67, $p$ < .04). The right groups suffered from significantly larger lesions. Main effects of locus ($F$ (3,44) = 3.49, $p$ < .07)

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and side by locus interaction ($F$ (3,44) = .10, $p$ < .76) failed to reach significance with respect to diameter. All main and interaction effects of side and locus of lesions on depth proved nonsignificant. Therefore, one index of severity indicates that the right groups underwent more severe injury and this may well explain the higher level of psychosocial difficulties experienced by these men. The significant results associated with one of the severity indices are consistent with Lishman's (1966) contention that severity of lesion and psychiatric disability are related.

Finally, one wonders if the fact that the right hemisphere is more diffusely organized (Semmes et al., 1960) is related to higher level of maladjustment. It is possible that involvement of any region of the right hemisphere may disrupt its homeostatic state while damage to the left hemisphere is more likely to eventuate in only focal consequences. Such an explanation is consistent with Kertesz' claim (1981) that functions may be rather diffusely distributed in the right hemisphere.

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Anterior Vs Posterior Damage

No significant findings were obtained with respect to the anterior-posterior continuum. Similar results were obtained in a study which examined the effects of open head injury on the intelligence test performance of this sample (Brandys, 1984). These negative results may attest to the crude division forced upon this study by the limited number of subjects. Although non-significant, the posterior groups obtained higher levels of maladjustment on the Emotional, Interpersonal, Adjustment to Seizures, Overall Psychosocial Functioning scales, as well as on the SMQ. The anterior groups fared worse on the Vocational, Financial, Medical Management, Neuropsychological Impairment scales as well as on the Intelligence scale. This last finding is consistent with previous results attesting to greatest intellectual deficits following lesions to the frontal regions of the brain (Shure & Halstead, 1958). Although cautious in their conclusions because of the nature of their population (cortical excision because of cerebral tumors) and its associated problem of metastasis, Shure and Halstead have nonetheless concluded that abstract thinking is more readily impaired by frontal than by nonfrontal

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lesions. In this respect, the present findings on the intelligence scale mirror Shure & Halstead's results.

WPSI Scales

As with Dodrill's results (1983), a brief examination of the relationships between variables suggests that, the greater the neuropsychological impairment and the lesser the WPSI Intelligence, the greater the likelihood that psychosocial difficulties will be noted.

Of all the measures used, the Adjustment Scale appears to be quite sensitive to the impact of seizures versus those of a head injury alone. In the majority of cases, patients still experiencing seizures, thus completing the WPSI, obtained a higher index of maladjustment. This finding may be explained by having to adjust in the long-term to two major insults, that of a head injury and of a seizure disorder. There is little doubt that the extra burden of seizures would add to the stigma following a head injury, and it is therefore likely that patients suffering from both conditions would have a more difficult adjustment period.

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With respect to the Intelligence index provided by the WPSI, it is the impression of this author that the scale tends to underestimate the intellectual capacity of the patients. The WPSI Intelligence Quotients ranged between 88 and 97, and such a narrow scatter is likely to represent a scale whose discriminative power is not very good. In certain cases where the intellectual capacities of a veteran were evaluated to be high average based on past and present work, complexity of vocabulary, as well as ease of expression, the ability was not reflected by the score obtained. Moreover, the fact that there is no correlation between the WPSI IQ index and the Wechsler-Bellevue IQ obtained 15 years after wounding, a time at which recovery may be considered complete, sheds additional doubt on the validity of this scale.

The interesting finding of elevated validity scale scores may serve as further validation for the WPSI scales. Although the WPI was designed to apply to all medical conditions, the nature of the present population rendered some of the items irrelevant. Is is doubtful that the mere substitution of one expression for another is all that is needed to create another reliable and valid scale. Consequently, one

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should be careful in using a scale primarily designed for a given population, despite adjustments.

Multiple Regression

Similar to the results obtained with respect to the side and locus of lesion on the WPSI and SMQ, only the side of lesion counted among the significant predictors of four clinical scales. The locus of lesion was not included in any of the regression models. This may well illustrate the arbitrary subdivision used in this study. The side of lesion was found to be a good predictor of Emotional Adjustment, Financial Status, Medicine and Medical Management, as well as Overall Psychosocial Functioning.

The two indices of severity of damage were among the significant predictors. Diameter significantly predicted Interpersonal Adjustment, Financial Status, Adjustment to Seizures and Overall Psychosocial Functioning, while depth of lesion predicted Emotional Adjustment, Medicine and Medical Management, and Overall Psychosocial Functioning. Aphasia was found to be the sole predictor of SMQ.

The best model, with 50% of the variance explained, was obtained on the Overall Psychosocial

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Functioning Scale. Depth, side, and diameter of lesion counted among the three significant predictors for this scale. As such, deeper and larger lesions, as well as right-sided lesions were associated with lower levels of adjustment. Therefore, with respect to predicting the adjustment level of an open head- injured individual, the multiple regression analyses suggest that knowledge of the side and severity of lesion would be most useful in predicting the overall psychosocial functioning of such an individual.

Of interest in Table 7 is the involvement of basic variables such as depth, side, and diameter of lesion in predicting psychosocial adjustment. Contrary to what may be expected from an association between the left-anterior damage and lower adjustment levels, aphasia, a symptom associated with left-sided lesions, never presented as a significant predictor for any of the WPSI scales.

Of further importance is the involvement of certain variables on different scales. For instance, the degree of paralysis is of significance on the Vocational Adjustment, Adjustment to Seizures/Head Injury, and Neuropsychological Impairment scales. The higher the degree of paralysis, the higher the

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maladjustment level on these scales. Although the scope of this study prevents a detailed exploration of all significant coefficients obtained, it is important to note that paralysis is likely to be of significance in the predicting of these three scales for different reasons. It is quite obvious that experiencing difficulty in moving limbs would conflict with job performance, although other reasons may need to be involved to explain the link between paralysis and adjustment to seizures/head injury, and neuropsychological impairment.

Finally, it is worth noting that the WPSI Intelligence Scale could not be predicted from any of the variables entered into the Multiple Regression analysis. This, together with the aforementioned criticisms concerning this scale, illustrates the limited usefulness and validity of this scale.

## Conclusions

The present study has added to the data concerning the differential impact of right- versus left-hemispheric lesions on a significant facet of human behavior. Based on the results, the conclusion that patients with penetrating damage to the right

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hemisphere are, in the long run, likely to recover to a lower level of adjustment than will left-hemispheric patients is warranted. The results do support a striking differential impact of damage to either hemisphere, although not in the predicted direction. This may well point to the problem of generalizing results pertaining to a given population to a slightly different one. Evidently, the stigma associated with a head injury bears additional consequences for the veteran in addition to the sole detrimental impact of seizures. There is no doubt that research would benefit from examining several factors which were not included in this investigation. For instance, family support is likely to influence the impact of a severe head trauma on one's capacity to adjust in everyday living. This information is available as part of the comprehensive questionnaire given to these veterans and future research in this area would certainly prove fruitful.

The implications which can be drawn from these results are of immense value, even moreso because of the paucity of studies relating open head injury to long-term levels of adjustment. The literature on open head injury suggests an association between

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catastrophic reactions and left-sided lesions and indifference with right-sided lesions. A presentation of this view is found in the writings of Gainotti (1969, 1972). Gainotti states that left-sided patients often show manifestations of anxiety and worry and often exhibit sudden and irrepressible crying spells during testing. On the other hand, right-sided patients exhibit indifference and sometimes euphoria and show a tendency to make puns.

Such a view, however, would lead to the hypothesis that patients with damage to the left hemisphere would adjust less well than would right-lesioned patients due to their catastrophic and anxious style. For their part, right-hemispheric patients would be expected not to exhibit any major difficulty in adjusting to their disability and surroundings since they are seemingly indifferent to their condition. However, the present study reveals results which seem to be counterintuitive to the description found in the literature. Indeed, these results suggest that right-hemispheric patients are the ones who exhibit the most difficulty in adjusting to different areas of their lives. If the association hereby presented of right-hemispheric patients and higher maladjustment levels can be

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replicated in future studies, a change in focus of the medical attention and rehabilitation programs may be needed. Based on the results of the current study, the patients with damage to the right hemisphere represent the population which truly needs to receive help to minimize the extent of their long-term psychosocial difficulties.

Finally, a reality that has received little recognition within the framework of this quantitative analysis is the remarkable recovery made by many of these men, despite the severity of their wounding. An incredibly high number of men were able to hold a job despite the seriousness of their injury and handicaps. As well, a few men who had experienced severe aphasic symptoms according to their charts were expressing themselves with an unsuspected ability based on the degree of their wounding. Furthermore, with the exception of two men living in Nursing homes, the majority managed to lead productive lives and, in general, reported a great deal of enjoyment. There is no doubt that a qualitative approach would add to our understanding of recovery from severe craciocerebral trauma. But until such research is undertaken, suffice it to say that the lifestyles characteristic of these

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men are evidence of the astonishing ability of the human brain to recover from serious injuries.

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# APPENDIX A

## THE THREE SCALES:
## I. WASHINGTON PSYCHOSOCIAL SEIZURE INVENTORY
## II. WASHINGTON PSYCHOSOCIAL INVENTORY
## III. SUBJECTIVE MEMORY QUESTIONNAIRE



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Date_____ No._____ WASHINGTON PSYCHOSOCIAL SEIZURE INVENTORY Name_____

Here are some questions about areas which are important for individuals having seizure problems. For each question, decide whether "Yes" or "No" best describes your usual feelings and actions. If the answer is "Yes" mark out the Y, like this: ● N. If the answer is "No" mark out the N, like this: Y ●. Do not circle your answers. Work quickly and go right from one question to the next. Try not to leave any blank.

1. Do you usually feel tired? Y N
2. Were you usually happy as a child? Y N
3. Do you need vocational counseling? Y N
4. Are you concerned people won't like you or want you around after a seizure? Y N
5. Do you like the area in which you live? Y N
6. Do you find it difficult to always take your medications when you should? Y N
7. Do you enjoy social gatherings? Y N
8. Do you feel you are losing your mind? Y N
9. Is your life free from problems? Y N
10. Do you have problems in the sexual area? Y N

11. Are you usually able to think clearly? Y N
12. Did you ever run away from home? Y N
13. Do your seizures keep you from driving? Y N
14. Do you usually feel included by others? Y N
15. Do you often have trouble sleeping? Y N
16. Is your vocational future bright? Y N
17. Are you always cheerful? Y N
18. Does your doctor completely understand all of your medical problems? Y N
19. Is inability to concentrate a problem? Y N
20. Do you have trouble making decisions? Y N

21. Have you ever seen a professional for counseling or psychotherapy? Y N
22. Are you generally free from depression? Y N
23. Have you ever felt tense or anxious? Y N
24. Are you free from problems with your family? Y N
25. Do you have more good days than bad? Y N
26. Would you move if you had the opportunity? Y N
27. Do you feel uneasy about the future? Y N
28. Does your doctor always spend as much time with you as you would like? Y N
29. Would you rather win than lose in a game? Y N
30. Can you accept the limitations your seizures place on you? Y N

31. Do you feel resentful that you have seizures? Y N
32. Do your medications affect your complexion? Y N
33. Do you feel useful at least most of the time? Y N
34. Have you ever lost a job because of your seizures? Y N
35. Have you ever been late for an appointment? Y N
36. Do you avoid social situations because of shyness? Y N
37. Do you need immediate psychiatric care? Y N
38. Do you have enough money to do most of the things you want to do? Y N
39. Would you be in another line of work if you did not have seizures? Y N
40. Do you feel you have full control of your mind? Y N

41. Are you content with your social contacts? Y N
42. Do you usually feel rested when you awake? Y N
43. Do you feel your doctor really cares about you as a person? Y N
44. Do you feel most people are phoney or insincere? Y N
45. Are you satisfied with your life as it is now? Y N
46. Do you have enough daily contact with people? Y N
47. As a child, did you have trouble making friends? Y N
48. Are you usually free from tension and worry? Y N
49. Do you have someone in whom you can confide? Y N
50. Have you ever felt sorry for yourself? Y N

51. Does epilepsy keep you from experiencing satisfaction in the area of work or employment? Y N
52. Are you losing your ability to think clearly? Y N
53. Do you feel completely comfortable with your doctor? Y N
54. Were you well accepted by your school teachers? Y N
55. Do you often feel guilty about your thoughts? Y N
56. Are you free from embarrassment about your seizures? Y N
57. Do people usually listen to what you are saying? Y N
58. Are you entirely capable of handling every situation? Y N
59. Have you engaged in sexual practices which cause you concern or worry? Y N
60. Is your life filled with activities that keep you interested? Y N

(over)

Adjustment Level 90

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61. Are you usually happy? Y N
62. Do you frequently have trouble remembering to take your medications? Y N
63. Do you often feel restless? Y N
64. Do you like your doctor? Y N
65. Do people frequently let you down? Y N
66. Are your feelings easily hurt? Y N
67. Have seizures ruined your life? Y N
68. Have you ever felt like swearing? Y N
69. Do you have enough friends? Y N
70. Have you ever had surgery for epilepsy? Y N

71. Does your seizure problem prevent you from getting a good job? Y N
72. Do you feel your seizures are being controlled as well as they can be? Y N
73. Do you have trouble meeting people? Y N
74. Do you feel financially secure? Y N
75 Do your medications make you less able to function? Y N
76. Have you ever disliked someone? Y N
77. Do you often wish you were dead? Y N
78. Do you have a close friend? Y N
79. Are you comfortable being alone despite possible seizures? Y N
80. Are you easily irritated? Y N

81. Do you often feel overworked? Y N
82. Are you dissatisfied with your present living situation? Y N
83. Do you have enough money? Y N
84. Do you always tell the truth? Y N
85. Did your parents frequently quarrel when you were growing up? Y N
86. Are you out of work because of your seizure problem? Y N
87. Do you have enough self-confidence? Y N
88. Do you sometimes wonder if you are on the wrong medication(s)? Y N
89. Do you have frequent thoughts of suicide? Y N
90. Are you free from aches and pains? Y N
91. Is transportation a problem? Y N
92. Are you fearful of accidents? Y N
93. Do you often feel people are trying to put something over on you? Y N
94. Are you often tense and anxious? Y N
95. Do you feel comfortable telling others you have seizures? Y N
96. Did you have a good relationship with your mother? Y N

97. Do you feel trapped in your present living situation? Y N
98. Are you anxious or uncomfortable in social situations? Y N
99. Have you ever been angry with anyone? Y N
100. Do you feel different or strange due to your seizures? Y N

101. Do you recall ever having Quidodzel's disease? Y N
102. Would you like to be closer to public transportation? Y N
103. Do you have trouble accepting your seizure problem? Y N
104. Would you be able to think more clearly if you did not have to take medications for your seizures? Y N
105. Do you constantly have trouble sleeping? Y N
106. Can you afford your present living arrangement? Y N
107. As a child, were you often punished without cause? Y N
108. Are you afraid people will find out you have seizures? Y N
109. Do you frequently want to harm others? Y N
110. Do you have a chance for vocational advancement? Y N

111. Do you continually dread the possibility of a seizure? Y N
112. Do you frequently find yourself in conflict with others? Y N
113. When growing up were you involved in a lot of fights? Y N
114. Do you usually feel at peace with yourself? Y N
115. Do you use alcohol or drugs excessively? Y N
116. Are you fearful you will have a seizure in an embarrassing circumstance? Y N
117. Do you resent having to take medications for your seizures? Y N
118. Are you free from worry about your health? Y N
119. Do you have enough money to pay your bills? Y N
120. Did you feel your parents really cared for you? Y N

121. Have you always been completely comfortable in all social situations? Y N
122. Do you feel at ease around people of the opposite sex? Y N
123. Do you strongly dislike other people who have seizures? Y N
124. Are you satisfied with your employment situation? Y N
125. Have you ever been teased because of your seizures? Y N
126. Does your doctor always take time to listen to you? Y N
127. Are you free from concerns in the vocational area? Y N
128. Do you hear voices when no one is around? Y N
129. Are you comfortable going out despite possible seizures? Y N
130. Do you have trouble expressing your opinions to others? Y N

131. Do you have sufficient money for basic needs? Y N
132. Did you feel secure in the home in which you grew up? Y N

PLEASE CHECK TO BE SURE YOU HAVE ANSWERED ALL THE QUESTIONS

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Date _____ No. _____ WASHINGTON PSYCHOSOCIAL INVENTORY Name _____

Here are some questions about areas which are important for individuals who have a medical condition like yours. For each question, decide whether "Yes or "No" best describes your usual feelings and actions. If the answer is "Yes" mark out the Y, like this: ● N. If the answer is "No" mark out the N, like this: Y ●. Do not circle your answers. Work quickly and go right from one question to the next Try not to leave any blank.

1. Do you usually feel tired? Y N
2. Were you usually happy as a child? Y N
3. Do you need vocational counseling? Y N
4. Are you concerned people won't like you or want you around with your medical condition? Y N
5. Do you like the area in which you live? Y N
6. Do you find it difficult to always follow your doctor's orders like you should? Y N
7. Do you enjoy social gatherings? Y N
8. Do you feel you are losing your mind? Y N
9. Is your life free from problems? Y N
10. Do you have problems in the sexual area? Y N
11. Are you usually able to think clearly? Y N
12. Did you ever run away from home? Y N
13. Does your medical condition keep you from driving? Y N
14. Do you usually feel included by others? Y N
15. Do you often have trouble sleeping? Y N
16. Is your vocational future bright? Y N
17. Are you always cheerful? Y N
18. Does your doctor completely understand all of your medical problems? Y N
19. Is inability to concentrate a problem? Y N
20. Do you have trouble making decisions? Y N
21. Have you ever seen a professional for counseling or psychotherapy? Y N
22. Are you generally free from depression? Y N
23. Have you ever felt tense or anxious? Y N
24. Are you free from problems with your family? Y N
25. Do you have more good days than bad? Y N
26. Would you move if you had the opportunity? Y N
27. Do you feel uneasy about the future? Y N
28. Does your doctor always spend as much time with you as you would like? Y N
29. Would you rather win than lose a game? Y N
30. Can you accept the limitations your medical condition places on you? Y N
31. Do you feel resentful that you have your medical condition? Y N
32. Does your treatment affect your complexion? Y N
33. Do you feel useful at least most of the time? Y N
34. Have you ever lost a job because of your medical condition? Y N
35. Have you ever been late for an appointment? Y N
36. Do you avoid social situations because of shyness? Y N
37. Do you need immediate psychiatric care? Y N
38. Do you have enough money to do most of the things that you want to do? Y N
39. Would you be in another line of work if you did not have your medical condition? Y N
40. Do you feel you have full control of your mind? Y N
41. Are you content with your social contacts? Y N
42. Do you usually feel rested when you awake? Y N
43. Do you feel your doctor really cares about you as a person? Y N
44. Do you feel most people are phony or insincere? Y N
45. Are you satisfied with your life as it is now? Y N
46. Do you have enough daily contact with people? Y N
47. As a child, did you have trouble making friends? Y N
48. Are you usually free from tension and worry? Y N
49. Do you have someone in whom you can confide? Y N
50. Have you ever felt sorry for yourself? Y N
51. Does your medical condition keep you from experiencing satisfaction in the area of work or employment? Y N
52. Are you losing your ability to think clearly? Y N
53. Do you feel completely comfortable with your doctor? Y N
54. Were you well accepted by your school teachers? Y N
55. Do you often feel guilty about your thoughts? Y N
56. Are you free from embarrassment about your medical condition? Y N
57. Do people usually listen to what you are saying? Y N
58. Are you entirely capable of handling every situation? Y N
59. Have you engaged in sexual practices which cause you worry or concern? Y N
60. Is your life filled with activities that keep you interested? Y N

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61. Are you usually happy? Y N
62. Do you frequently have trouble remembering to follow your treatment? Y N
63. Do you often feel restless? Y N
64. Do you like your doctor? Y N
65. Do people frequently let you down? Y N
66. Are your feelings easily hurt? Y N
67. Has your medical condition ruined your life? Y N
68. Have you ever felt like swearing? Y N
69. Do you have enough friends? Y N
70 Have you ever had surgery for your medical condition? Y N

71. Does your medical condition prevent you from getting a good job? Y N
72. Do you feel your medical condition is being treated as well as it can be? Y N
73. Do you have trouble meeting people? Y N
74. Do you feel financially secure? Y N
75. Is there anything in your treatment that is making you worse? Y N
76. Have you ever disliked someone? Y N
77. Do you often wish you were dead? Y N
78. Do you have a close friend? Y N
79. Are you comfortable being alone despite your medical condition? Y N
80. Are you easily irritated? Y N

81. Do you often feel overworked? Y N
82. Are you dissatisfied with your present living situation? Y N
83. Do you have enough money? Y N
84. Do you always tell the truth? Y N
85. Did your parents frequently quarrel when you were growing up? Y N
86. Are you out of work because of your medical condition? Y N
87. Do you have enough self-confidence? Y N
88. Do you sometimes wonder if you are on the wrong treatment? Y N

89. Do you have frequent thoughts of suicide? Y N
90. Are you free from aches and pains? Y N
91. Is transportation a problem? Y N
92. Are you fearful of accidents? Y N
93. Do you often feel people are trying to put something over on you? Y N
94. Are you often tense and anxious? Y N
95. Do you feel comfortable telling others about your medical condition? Y N
96. Did you have a good relationship with your mother? Y N
97. Do you feel trapped in your present living situation? Y N
98. Are you anxious or uncomfortable in social situations? Y N
99. Have you ever been angry with anyone? Y N

100. Do you feel different or strange due to your medical condition? Y N

101. Do you recall ever having Quidodzel's disease? Y N
102. Would you like to be closer to public transportation? Y N
103. Do you have trouble accepting your medical condition? Y N
104. Would you be able to think more clearly if you did not have to take treatment for your medical condition? Y N
105. Do you constantly have trouble sleeping? Y N
106. Can you afford your present living arrangement? Y N
107. As a child, were you often punished without cause? Y N
108. Are you afraid people will find out about your medical condition? Y N
109 Do you frequently want to harm others? Y N
110 Do you have a chance for vocational advancement? Y N

111. Do you continually dread problems that may come from your medical condition? Y N
112. Do you frequently find yourself in conflict with others? Y N
113. When growing up were you involved in a lot of fights? Y N
114. Do you usually feel at peace with yourself? Y N
115. Do you use alcohol or drugs excessively? Y N
116. Are you fearful that your medical condition will be noticed by others in an embarrassing circumstance? Y N
117. Do you resent having to take treatments for your medical condition? Y N
118. Are you free from worry about your health? Y N
119. Do you have enough money to pay your bills? Y N
120. Did you feel your parents really cared for you? Y N

121. Have you always been completely comfortable in all social situations? Y N
122. Do you feel at ease around people of the opposite sex? Y N
123. Do you strongly dislike other people who have your medical condition? Y N
124. Are you satisfied with your employment situation? Y N
125. Have you ever been teased because of your medical condition? Y N
126. Does your doctor always take time to listen to you? Y N
127. Are you free from concerns in the vocational area? Y N
128 Do you hear voices when no one is around? Y N
129. Are you comfortable going out despite your medical condition? Y N
130. Do you have trouble expressing your opinions to others? Y N

131. Do you have sufficient money for basic needs? Y N
132. Did you feel secure in the home in which you grew up? Y N

**PLEASE CHECK TO BE SURE YOU HAVE ANSWERED ALL THE QUESTIONS**

MEMORY QUESTIONNAIRE (Bennett-Levy & Powell, 1980)

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| very bad | bad | average | good | very good |

How good is your memory for:

1. Names of people a few minutes after being introduced?____
2. Names of people a few days or weeks later____
3. Birthdays?____
4. Telephone numbers?____
5. Shopping lists?____
6. Remembering where you put things?____
7. Appointments?____
8. Faces?____
9. Theme of tune of songs?____
10. Lyrics of songs?____
11. Names of streets?____
12. Theme of a book you have recently read?____
13. Number of a house?____
14. Details of a book read (names of characters)?____
15. Train or bus times?____
16. Jokes?____
17. Mathematical formulae or conversions (miles into kilometers)?____
18. Facts about people (where you met them, what they do)?____
19. Where you have left off in a book?____
20. Color codes?____
21. When you have borrowed something, giving it back?____
22. Names of public figures attached to particular jobs?____
23. Details of shoe and clothes sizes...of friends/wife?____
24. Signs (traffic)?____
25. When you last did things (e.g. water plants)?____
26. Giving messages (phone messages) to people?____
27. Right/left orientation (turning key to the left or right)?____
28. Names of actors in films?____
29. Names of titles of films?____
30. Everyday times (time of tv news)?____
31. Learning new skills? (gears of new car, typing)____
32. Learning movements (e.g. dance steps)____

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33. Directions on how to get somewhere?___
34. Matching colors?____
35. Recalling your dreams?____
36. Spelling words?____

Do you often:

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| very rarely | rarely | sometimes | quite often | very often |

37. Set off to do something, then cannot remember what?____
38. Forget what you were going to say in mid-sentence?____
39. Forget a particular word in mid-sentence?____
40. Forget whether or not you have locked up the house or turned off the lights?____
41. Find you are unable to place voices you have heard before?____
42. Find you are unable to place faces you have seen before?
43. Look at a map to find a route to somewhere, then have to recheck one minute later?____

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# APPENDIX B

## WPSI PROFILE FORM



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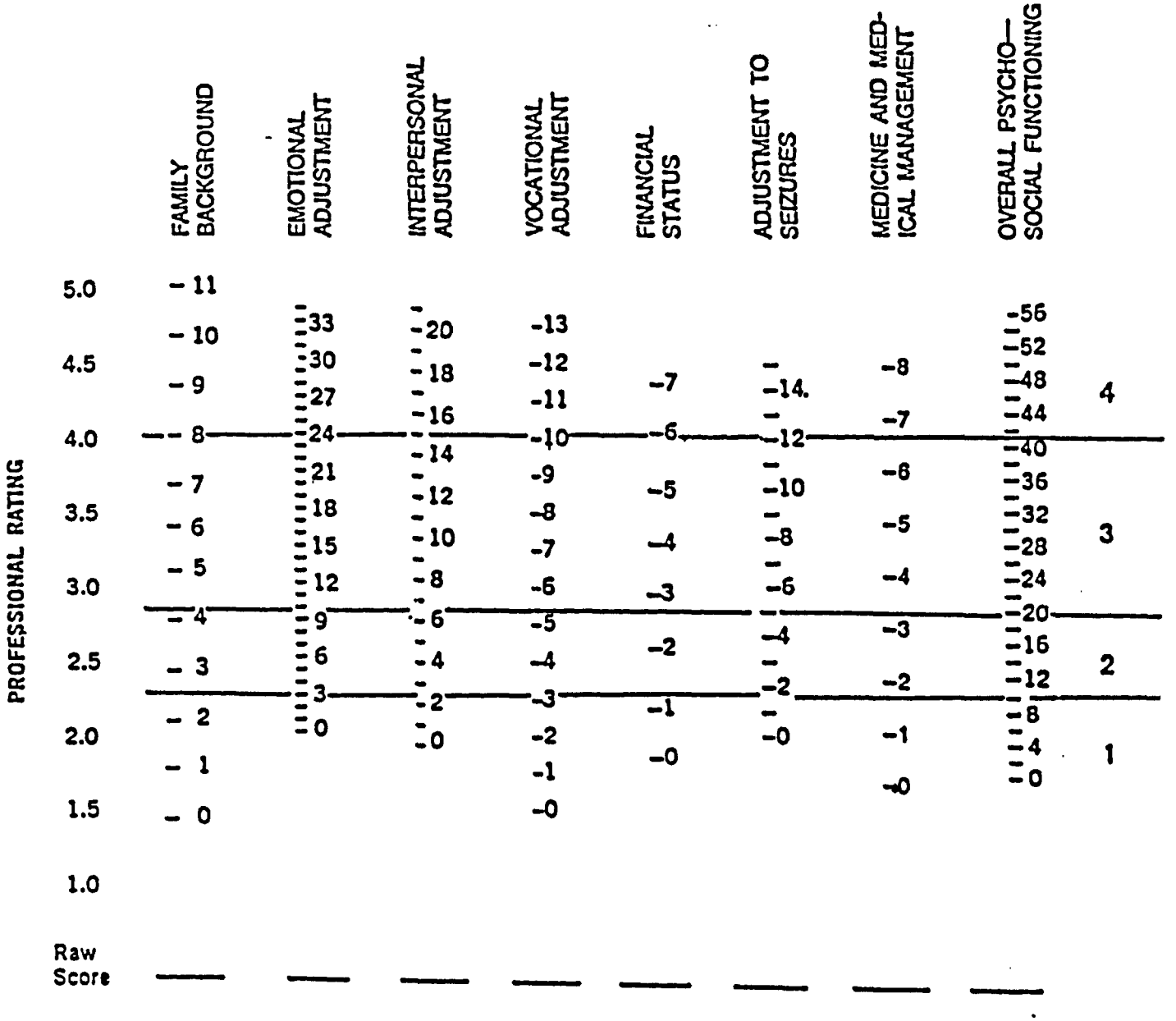
# WASHINGTON PSYCHOSOCIAL SEIZURE INVENTORY

Profile Form




Validity Scales

A

No. Blank____
Critical ____
Impairment____ (___%)
Intelligence____ (___)

B

Lie____

C

Rare Items____

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# APPENDIX C

## INTRODUCTORY LETTER SENT TO ALL VETERANS



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Adjustment Level 99

Henry Ford Hospital
2799 West Grand Boulevard
Detroit, Michigan 48202

July 5, 1985

Name
Address
Address

Dear Mr. _____,

It has been 40 years since I saw you as a patient at Cushing General Hospital when you were suffering from a head injury. Through the years I have periodically tried to contact each of the many men I treated from 1945-1946. As the 40th anniversary approaches, I would like to contact many of you and see how you are getting along.

Besides my personal interest in you, our present contact with you will provide us with an additional opportunity to study the long term effects on people with a head injury. We are seeking information regarding your present health and social life. This will require approximately 60 minutes of your time on the phone answering questions. If you have difficulty talking or expressing yourself, maybe you could arrange to have a friend or relative present who could help you. All the information you supply will be kept confidential. Please return the enclosed letter with your name, address, phone number and time when it would be convenient for you to be contacted. Also, if you have questions regarding the project or if you wish to set up an appointment, feel free to call toll free at 1-800-521-7946, extension 2526, between 9am and 5pm Eastern Standard Time. Upon receiving your agreement to participate, my assistants, Cathie Zmachinski or Andree Tellier, will get back in touch with you.

You have been very helpful in the past. I trust you will again support our continuing effort to study the effects of head injury. We hope that the results of this study may help us to care more effectively for you and others who have suffered head injuries.

We look forward to hearing from you.

Sincerely,

A. Earl Walker, M.D.

Andree Tellier,
Research Coordinator

Cathie Zmachinski,
Research Coordinator

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VOLUNTEER AGREEMENT

I, _____, am willing to participate in the further study of the effects of head injuries. I understand that it will require 1 hour on the phone answering questions about my health and social life. As before, all information and responses will remain confidential and under the supervision of Dr. Walker.

_____ _____

Signature Date

Please print Name, Address and Phone Number below:

NAME:_____

ADDRESS:_____
(Street)

_____
(City) (State) (Zip Code)

HOME PHONE:_____
(Area Code)

********

We have listed below several times when phone interviews could be conveniently conducted. But let us assure you, these are not the only times available. Please indicate when it would be convenient for you to have the phone interview conducted. (These times are Eastern Standard Times).

Monday 5pm___6___7___8___
Tuesday 5pm___6___7___8___
Wednesday 5pm___6___7___8___
Thursday 9am___10___11___12___1pm___2___3___4___5___6___7___8___
Friday 4pm___5___6___7___8___
Saturday 9am___10___11___12___1pm___2___3___4___5___6___7___8___
Sunday 1pm___2___3___4___5___6___7___8___

Other:_____
(Day and Time)

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To further our understanding of how you are getting along, we would like to have someone who knows you well answer some questions on your day-to-day functioning. These questions will be sent after we have talked with you.

I agree to allow Mr./Ms./Mrs._____ to complete a questionnaire. They can be reached at the following address:

NAME_____

STREET_____

CITY/STATE_____

ZIP CODE_____

HOME PHONE_____

(Please print carefully)

Relationship to Veteran_____

Length of time this person has known you:_____
(years)

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If you have any questions about our Head Injury Study, please contact one of the research coordinators, Andree Tellier or Cathie Zmachinski, toll free, at the following number between 9am & 5pm Eastern Standard Time:

1-800-521-7946, extension 2526

Responses should be addressed to:

Head Injury Project
Department of Psychiatry
Henry Ford Hospital
2799 West Grand Boulevard
Detroit, Michigan 48202

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# APPENDIX D

## THANK-YOU LETTER



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Adjustment Level 104

Henry Ford Hospital
2799 West Grand Boulevard
Detroit, Michigan 48202

DATE

NAME
ADDRESS

Dear Mr. _____,

I would like to thank you once again for allowing me to conduct the interview on the _____(date). It really was a pleasure to talk to you.

As mentionned on the phone, I am now sending you a portion of the questionnaire that may be easier for you to answer at home. That way, you may take as much time as necessary to answer the questions. Once again, if you feel uncomfortable answering some of the questions, feel free to leave them unanswered. I would like to remind you however that everything will remain confidential

Many thanks for your participation and time and on behalf of Dr. Walker and myself, I send you (and your family, if applicable) sincere wishes for the years to come.

Sincerely yours,

_____
Andree Tellier
Research Assistant

If you wish to contact Dr. Walker, you may do so at the following address and phone number:

University of New Mexico
School of Medicine
1007 Stanford Dr. N.E.
Albuquerque, New Mexico 87130

Phone Number: (505) 277-3401
*You may call collect.

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# VITA AUCTORIS

Andrée Tellier was born on January 19, 1962 in Montréal, Québec to Réjane Boucher and Jean-Guy Tellier. In June 1979, she obtained her high school diploma from the Polyvalente Henri-Bourassa, Montreal-North, Québec. She spent the following year as an AFS student at Ramapo High School in Franklin Lakes, New Jersey. In June 1984, she graduated from McGill University with a Bachelor of Arts degree with Distinction, major in psychology. Since the fall of 1984, she has been enrolled in the Doctoral programme in Human Clinical Neuropsychology at the University of Windsor. She spent her summer of 1985 as a research coordinator at the Henry Ford Hospital in Detroit and her summer of 1986 as a practicum student at the Children's Hospital of Michigan in Detroit. She obtained her Master's Degree in the fall of 1986 from the University of Windsor.



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