Journal of the International Neuropsychological Society (1998), **4**, 380–387.

Characteristics of impaired awareness after traumatic brain injury

MARK SHERER,[1,2] CORWIN BOAKE,[3,1] ELLEN LEVIN,[1,2] BERNARD V. SILVER,[1,2] GEORGE RINGHOLZ,[2] AND WALTER M. HIGH, Jr.[2,1]

[1]The Institute for Rehabilitation and Research
[2]Baylor College of Medicine, Houston, TX
[3]University of Texas Health Science Center at Houston, Houston, TX

(RECEIVED May 13, 1997; REVISED September 19, 1997; ACCEPTED November 17, 1997)

Abstract

Impaired awareness of the effects of brain injury is a commonly observed and poorly understood finding in traumatic brain injury survivors. Nonetheless, impaired awareness has been identified as a major factor in determining outcome for traumatic brain injury survivors. Review of previous studies of impaired awareness in this patient population revealed a number of preliminary findings regarding the nature of this phenomenon. The present paper presents the results of 2 new studies with a total of 111 traumatic brain injury patients conducted to bring further clarity to this area. Findings confirmed and extended many results of previous investigations. Specific findings included patient overestimation of functioning as compared to family member ratings, patient report of greater physical than nonphysical impairment, greater patient–family agreement on specific ratings of patient functioning than on general ratings, greater agreement of family and clinician ratings of patient functioning with each other than with patient self-ratings, and partial disagreement of different methods of measuring impaired awareness. (*JINS*, 1998, *4*, 380–387.)

Keywords: Impaired awareness, Traumatic brain injury, Characteristics, Measurement, Awareness Questionnaire

INTRODUCTION

Impaired awareness of deficits is a frequent finding after acquired brain injury (Goldstein, 1939; Weinstein & Kahn, 1955). Such impaired awareness has been described in patients with brain injury due to stroke, dementia, and traumatic brain injury (McGlynn & Schacter, 1989). Clinicians working to rehabilitate patients who have suffered traumatic brain injury generally agree that impaired self-awareness significantly complicates the rehabilitation process (Ben-Yishay et al., 1985; Prigatano & Fordyce, 1986). Consequently, there has been interest in developing methods of assessing unawareness so that its effect on rehabilitation outcome can be studied and the efficacy of treatment methods aimed at improving awareness can be assessed.

Previous studies of impaired awareness in patients with traumatic brain injury have measured awareness in a number of ways using several different questionnaires and rating scales. These studies have produced a variety of preliminary findings regarding the nature of impaired awareness. Some of these findings are inconsistent across studies or have not yet been replicated. The apparent inconsistency of some of these findings may be the result of the different ways that awareness has been measured in the various studies. There has been only very limited investigation of the comparability of different methods of measuring awareness. The present paper presents a comprehensive review of previous findings regarding the nature of impaired awareness after traumatic brain injury. Methodologies used to measure impaired awareness are also reviewed. Finally, the results of two new investigations of the characteristics of impaired awareness after traumatic brain injury are presented.

Characteristics of Impaired Awareness

Clinical observation suggests that impaired awareness after traumatic brain injury is a complicated phenomenon. Some patients, particularly in the acute period, may be unaware that they have suffered any injury at all. Other patients ad-

Reprint requests to: Mark Sherer, Mississippi Methodist Rehabilitation Center, 1350 East Woodrow Wilson, Jackson, MS 39216. USA. E-mail: marks@mmrcrehab.org

mit to some deficits but fail to perceive the likely impact of these deficits on their daily activities. Still other patients seem keenly aware of postinjury changes and experience significant depression. Empirical investigation of the nature and course of impaired awareness in traumatic brain injury is still at an early stage. However, previous studies have examined some characteristics of impaired awareness.

Findings regarding the neuroanatomic basis of impaired awareness after traumatic brain injury are quite limited. Since traumatic brain injury is known to produce diffuse cerebral damage, it is difficult to study the contribution of damage to any particular cerebral region to impaired awareness. In patients with focal lesions, it is thought that the frontal lobes (Damasio & Anderson, 1993; Stuss, 1991) and the right hemisphere (Heilman et al., 1993) have special roles in self-awareness. To date, no study has attempted to examine the possible association between amount of frontal lobe injury after traumatic brain injury and degree of impaired awareness. Two studies have examined the possible contribution of right hemisphere lesions. Ranseen et al. (1990) found greater unawareness in traumatic brain injury patients with focal right hemisphere injuries as compared to those with focal left hemisphere injury or diffuse injury. Prigatano and Altman (1990) failed to find a greater incidence of right hemisphere lesions in patients who overestimated their behavioral competencies as compared to those who did not. However, patients with more identifiable lesions on CT or MRI scan had poorer awareness than those with fewer lesions even though the groups did not differ on mean Glasgow Coma Scale score. Clinical experience suggests that patients with more severe brain injury may experience greater impairment of their self-awareness. However, three studies that have investigated this issue (Allen & Ruff, 1990; Anderson & Tranel, 1989; Gasquoine, 1992; Prigatano & Altman, 1990) failed to find an association between neurologic indices of severity of injury and degree of unawareness. These results may be an artifact of the restricted range of severity used in most studies. Levin et al. (1987) did find that clinician ratings of patients' accuracy of self-appraisal were related to severity of injury with more severely injured patients showing greater impairment.

Clinical experience also suggests that impaired awareness may be related to patients' general cognitive and emotional functioning. Studies of the association between severity of cognitive deficits and impaired awareness have yielded inconsistent results. One study (Anderson & Tranel, 1989) found that greater cognitive impairment was associated with poorer self-awareness, while other studies have found no association (McKinlay & Brooks, 1984; Prigatano & Altman, 1990). Studies of the relationship of emotional functioning and awareness have found that patients who admit to more impairment report a greater level of emotional distress (Gasquoine, 1992; Godfrey et al., 1993; Heaton & Pendleton, 1981).

Impaired awareness is not a global deficit. Degree of impairment appears to depend on the area of functioning assessed and the type of item used to make the assessment. Traumatic brain injury survivors have been found to be more aware of their physical deficits than their nonphysical (cognitive and emotional) impairments (Anderson & Tranel, 1989; Gasquoine, 1992; Hendryx, 1989; McKinlay & Brooks, 1984; Prigatano, 1996; Prigatano et al., 1990). Further, one study (Gasquoine, 1992) found that patients were more likely to report deficits when asked specific questions about their functioning than when asked general or open-ended questions.

Measurement of Impaired Awareness

To date, four methods of operationalizing impaired awareness have been used. Three of these approaches involve comparing patient self-report of cognitive, physical, social, and other areas of functioning to some other standard. It is assumed that patients with impaired self-awareness will rate their abilities as better or more intact than the standard. The discrepancy between the patient's self-rating and the standard is considered to be a measure of the degree of patient unawareness. One such method is comparison of the patient's self-rating to the rating of a family member (Fordyce & Roueche, 1986; Hendryx, 1989; McKinlay & Brooks, 1984; Prigatano, 1996; Prigatano et al., 1990; Prigatano & Altman, 1990; Walker et al., 1987). As expected, results of studies using this method consistently find that traumatic brain injury survivors rate themselves as less impaired than do family members. A possible threat to the validity of this method of measuring awareness would be inability of family members to accurately rate patients' abilities. Romano (1974) found that some families deny the severity of patients' deficits and McKinlay and Brooks (1984) found that family member personality characteristics affect their ratings of patient functioning.

Another standard to which patients' self-ratings may be compared is the judgment of clinicians who are familiar with the patient's functioning (Fordyce & Roueche, 1986; Gasquoine, 1992; Gasquoine & Gibbons, 1994; Heilbronner et al., 1989; Ranseen et al., 1990). Studies using this approach have found that patients rate themselves as less impaired than do clinicians. Clinician emotional response to the patient could be a threat to the validity of this method (Heilbronner et al., 1989).

The third standard of comparison to which patients' self-ratings may be contrasted is the patient's performance on objective measures of cognitive functioning (Allen & Ruff, 1990; Anderson & Tranel, 1989; Heaton & Pendleton, 1981). Studies using this method have generally found that traumatic brain survivors underestimate the severity of deficits that they show on neuropsychological tests. Allen and Ruff (1990) found that while controls were generally more accurate in their self-ratings than head-injured patients, they also overestimated their true abilities on some tasks.

All methods of measuring awareness that use patient self-ratings depend on patients having some capacity to reliably rate their abilities even though such ratings are likely to be overestimates. Clearly, such an assumption is not warranted

https://doi.org/10.1017/S1355617798003804 Published online by Cambridge University Press

for nonresponsive or acutely confused patients (Priddy et al., 1988). However, there is evidence that some oriented patients may be too cognitively impaired to produce meaningful self-ratings (Boake et al., 1995). Other studies (Fordyce & Roueche, 1986; Gasquoine & Gibbons, 1994) have reported adequate test–retest reliability for patient self-ratings indicating that their patients were able to respond in a meaningful manner. This issue deserves further investigation, but clinicians should consider screening patients to insure that they are able to reliably comply with the task demands of self-rating scales.

The final method of assessing impaired awareness is for a clinician to directly rate the patient's accuracy of self-appraisal (Ezrachi et al., 1991; Fleming et al., 1996; Levin et al., 1987). This approach requires that the clinician be very familiar with the patient and not be influenced by patient characteristics such as attractiveness, likability, or verbal expressive ability.

Little is known about the comparability of these four methods of measuring impaired awareness. Fordyce and Roueche (1986) found that clinician and family members differed in their ratings of patient functioning. This result indicates that level of unawareness, as measured by the discrepancy between patient self-ratings and clinician ratings, may differ from level of unawareness as measured by the discrepancy between patient self-ratings and family member ratings. Additional investigation of the comparability, or lack of comparability, of different methods of measuring self-awareness is needed.

A number of measurement instruments have been used in the various studies of impaired awareness after traumatic brain injury and still other measures of impaired awareness have been developed for other populations such as stroke survivors. Measures used primarily with traumatic brain injury survivors include the Patient Competency Rating Scale (Prigatano et al., 1986), the Awareness Interview (Anderson & Tranel, 1989), the San Diego Questionnaire (Allen & Ruff, 1990), the Self-Awareness Questionnaire (Gasquoine & Gibbons, 1994), the Self-Awareness of Deficits Interview (Fleming et al., 1996), and others. Some of these measures have been used in only one published study. There has been little investigation of the psychometric properties or factor structures of these instruments. To date, there has been no investigation of the comparability of these various scales. Review of the strengths and weaknesses of these scales is beyond the scope of the present paper.

The present paper presents two new studies conducted to cross-validate and extend some of the findings summarized above. These two studies investigated hypotheses based on results of previous studies and implications of current conceptualizations of impaired awareness after traumatic brain injury. Specific issues addressed included (1) comparison of patient and family member perceptions of patient functioning, (2) patient responses to specific questions regarding impairments as opposed to more generally worded questions, (3) family member responses to specific questions regarding patient impairment as opposed to more generally worded questions, (4) comparison of patient–family member agreement on specific questions as opposed to general questions, (5) comparison of clinician ratings of patient functioning with patient and family member ratings of patient functioning, and (6) agreement of clinician ratings of patients' level of impaired awareness with impaired awareness measured as the discrepancy between patient and family member ratings of patient functioning.

STUDY 1

Study 1 tested hypotheses regarding differences between patient and family member ratings of traumatic brain-injured patients' functioning as well as hypotheses regarding patient and family member differential responding to general items as compared to specific items. Finally, patient and family member reports of physical deficits as compared to nonphysical (cognitive and behavioral) deficits were examined. The following hypotheses were proposed based on previous studies and clinical experience with unawareness in patients with traumatic brain injury:

1. On both general and specific questions, traumatic brain injured patients will report less impairment than their family members.
2. On general questions, patients will complain less of nonphysical (i.e., cognitive and behavioral) than of physical impairments.
3. On both general and specific questions, family members will complain more of nonphysical than of physical impairments.
4. Patient and family responses will agree more closely on specific questions than on general questions.

Methods

Participants were 64 patients with nonpenetrating traumatic brain injury who were treated at a rehabilitation hospital. Severity of injury was determined by Glasgow Coma Scale (GCS; Teasdale & Jennet, 1974) criteria (3–8 = *severe*, 9–12 = *moderate*, 13–15 = *mild*) and review of original medical records. GCS scores were available for 51 participants. Of the 64 patients, 48 suffered severe injuries, 10 suffered moderate injuries, and 6 suffered mild injuries. Neuroradiologic studies were not available for all participants and a variety of different studies were done at a variety of times postinjury. As a result, these findings could not be analyzed in the present study. Neuropsychological evaluations of patients were not generally done concurrent with assessment of level of awareness and a variety of tests were used with different patients. Consequently, these results were not analyzed as part of the current studies. However, all patients showed evidence of neuropsychological impairment at some time following their injuries. The majority of patients were young men (52 male, 12 female) with at least some high school education who had been injured in motor

https://doi.org/10.1017/S1355617798003804 Published online by Cambridge University Press

vehicle crashes ($M \pm SD$ for age = 28.8 ± 9.8 years; education = 12.1 ± 2.1 years).

Patients completed a questionnaire (the Awareness Questionnaire) developed to permit testing of the hypotheses of this study at a mean postinjury interval of 13.0 ± 20.8 months (range 0.9–91.6 months). Scale items for the Awareness Questionnaire were developed based on clinical experience of the authors as well as review of previous studies of impaired awareness in brain injury patients. Items required the respondents to rate functioning in the areas of physical, cognitive, behavioral, and community functioning. Clinical experience indicates that some patients may have some awareness of their primary deficits but fail to appreciate how these deficits would limit their return to work, personal independence, or other functional activities. Community functioning items were included to attempt to assess this phenomenon. On some items, the respondents rated general areas of functioning (general items) while on other items the respondent rated functioning in specific situations (specific items). General items require a comparison of the patient's ability to perform in a certain area at the time of completion of the scale as compared to the patient's ability to function in this area prior to suffering a traumatic brain injury. Responses to these items are rated on a 5-point scale ranging from *much worse* to *much better*. Sample general items are presented in Table 1. Specific items require rating of the frequency with which a certain problem occurs on a 5-point scale ranging from *all the time* to *never*. Sample specific items are presented in Table 2. To test the hypotheses of Study 1, cognitive and behavioral items scores were analyzed together as nonphysical items. Four scores were generated by calculating the mean ratings of general physical and nonphysical items and specific physical and nonphysical items for each respondent. Different forms of the scale were used to obtain ratings of the patient's functioning from the patient and a family member or significant other. Both forms consisted of 26 general items and 20 specific items. The forms were identical in content except for minor rewording of the items to the third person on the family member form. All patients were oriented at the time of evaluation. The questionnaire was individually administered to patients by reading the items aloud and recording the patient's responses. If there was any indication that the patient did not understand an item, the examiner gave further explanation. This was only rarely required. The family ratings were obtained close to the same date (within 1 week) by a family member who knew the patient well before and after the injury. Family raters for the 64 patients were 14 spouses, 39 parents, 7 siblings, 2 significant others, and 2 friends.

Table 1. Examples of general and community functioning items

"How well are you able to move your arms and legs now as compared to before your injury?"
"How good is your memory for recent events now as compared to before your injury?"
"How well can you keep your feelings in control now as compared to before your injury?"
"How good is your ability to work and hold a job now as compared to before your injury?"

1	2	3	4	5
Much worse	*A little worse*	*About the same*	*A little better*	*Much better*

Table 2. Examples of specific items

"How often do you fall or have trouble doing things because of difficulty getting around?"
"How often do you forget appointments or other things you need to do?"
"How often do you say things around others that you feel embarrassed about later?"

1	2	3	4	5
All the time	*Very often*	*Often*	*Rarely*	*Never*

Results

Hypothesis 1 was tested with two two-way repeated-measures analyses of variance (ANOVA) in which the independent variables were respondent (patient *vs.* family member) and domain of functioning (physical *vs.* nonphysical). The ANOVA was computed separately for the general items and the specific items. Hypothesis 2 was tested with a paired-sample *t* test comparing the patients' mean general ratings between domains of functioning. Hypothesis 3 was tested with paired-sample *t* tests comparing family members' general and specific ratings between domains of functioning. Finally, Hypothesis 4 was tested by computing Pearson product–moment correlations among the general item ratings and the specific item ratings.

Mean general ratings are presented in Table 3 and specific ratings are presented in Table 4. On the general items, patients reported less impairment than family members, as

Table 3. Means (standard deviations) for general ratings

	Rater			
	Patient		Family	
Domain of functioning	*M*	(*SD*)	*M*	(*SD*)
Nonphysical	2.86	(.64)	2.14	(.61)
Physical	2.74	(.54)	2.37	(.44)

https://doi.org/10.1017/S1355617798003804 Published online by Cambridge University Press

Table 4. Means (standard deviations) for specific ratings

	Rater			
	Patient		Family	
Domain of functioning	*M*	(*SD*)	*M*	(*SD*)
Nonphysical	3.94	(.59)	3.74	(.70)
Physical	4.16	(.55)	4.14	(.63)

predicted in Hypothesis 1 [$F(1,63) = 47.94$, $p < .001$]. The prediction of Hypothesis 2 that patients would report greater physical than nonphysical impairment was also supported [$t(63) = 1.84$, $p < .04$, one-tailed]. The prediction of Hypothesis 3 that family members would report more nonphysical than physical impairment was also supported [$t(63) = 3.36$, $p < .001$].

On the specific items, patients and family members did not differ in their report of degree of impairment [$F(1,63) = 2.50$, $p > .119$]. Thus, this part of Hypothesis 1 was not supported. As predicted in Hypothesis 3, family members reported greater nonphysical than physical impairments [$t(63) = 5.90$, $p < .001$].

Correlations between patient and family ratings are presented in Table 5. All correlations between patient and family member ratings were in the predicted direction. As predicted in Hypothesis 4, product–moment correlations between patients' and family members' ratings were greater for specific items than for general items.

STUDY 2

Hypotheses for Study 2 explored the possible comparability of different ways of measuring impaired awareness. The three methods examined were patient–family comparison, patient–clinician comparison, and clinician rating of patients' accuracy of self-appraisal. Since clinician ratings and family ratings are both standards to which patient self-ratings can be compared to measure level of awareness, these ratings should be more strongly associated with each other than with patient ratings. Also, patient–family differences on general items should be more strongly associated with other measures of impaired awareness than patient–family differences on specific items. The following hypotheses were proposed based on previous studies and clinical experience with unawareness in patients with traumatic brain injury:

1. Clinician and family ratings of patient general physical, cognitive, behavioral, and community functioning will be more strongly correlated with each other than with patient general self-ratings of functioning.
2. Difference scores calculated by subtracting family ratings of patient general physical, cognitive, behavioral, and community functioning from patient general ratings will be correlated with clinician rating of patient accuracy of self-awareness.
3. Patient–family difference scores on general ratings will be more strongly correlated with clinician rating of patient accuracy of self-awareness than will patient–family differences on specific ratings.

Exploratory analyses investigated the relationships between measures of awareness and severity and chronicity of injury.

Table 5. Correlations between patient and family ratings

Domain of functioning	Specific *r*	General *r*
Nonphysical	.57***	.30**
Physical	.47***	.22*

*$p < .05$, one-tailed.
**$p < .01$, one-tailed.
***$p < .001$, one-tailed.

Methods

Participants for Study 2 were a new sample of 47 TBI survivors with an average age of 30.9 years ± 12.7 and average education of 11.8 years ± 2.4. There were 36 male participants and 40 were right-handed. Severity of injury was determined by GCS criteria and review of original medical records. GCS scores were available for 34 participants. Of the 47 patients, 33 suffered severe TBI (GCS 3–8), 7 suffered moderate TBI (GCS 9–12), and 7 suffered mild TBI (GCS 13–15). Patients and family members completed the Awareness Questionnaire forms described in Study 1. To test the hypotheses of Study 2, cognitive and behavioral items were analyzed separately rather than being combined as in Study 1. Family raters for the 47 patients were 20 spouses, 19 parents, 4 siblings, 2 grandparents, and 2 significant others. Ratings of patient functioning were also obtained from clinicians who had worked with each participant for 2 weeks in the context of a comprehensive outpatient brain injury rehabilitation program. An additional questionnaire was developed to obtain these clinician ratings for this study. This questionnaire contained items on which the clinician rated the patient's general physical, cognitive, behavioral, and community functioning as well as an item on which the clinician rated the patient's accuracy of self-awareness. Sample items from the clinician questionnaire are presented in Table 6. Data from participant, family member, and clinician raters were collected an average of 7.4 ± 12.5 months postinjury. The interval from injury to testing for each patient was used as the chronicity variable. Clinicians were blinded to patient self-ratings and family member ratings.

Results

All correlations reported are Pearson product–moment correlations. Correlations of patient, family, and clinician gen-

https://doi.org/10.1017/S1355617798003804 Published online by Cambridge University Press

Table 6. Examples of items from the Clinician Rating Scale

"To what extent are the patient's cognitive abilities impaired by his/her brain injury?"				
"To what extent is the patient's emotional/behavioral functioning impaired by his/her brain injury?"				
"To what extent is the patient's ability to work or go to school impaired by his/her brain injury?"				
"To what extent is the patient's accurate self-awareness impaired by his/her brain injury?"				
1	2	3	4	5
Completely	*Severely*	*Moderately*	*Minimally*	*Not at all*

eral ratings are presented in Table 7. For all of these ratings, since higher scores corresponded to less impairment, positive correlations indicate agreement between ratings while negative correlations indicate disagreement. As predicted, family and clinician ratings for physical and community functioning correlated more strongly with each other than either correlated with patient ratings. This predicted pattern failed to obtain for cognitive and behavioral ratings. An incidental finding was that patient and family ratings of patient behavioral functioning were significantly positively associated while patient and clinician ratings were negatively associated. This finding warrants further investigation as it suggests that clinicians and patients and family members may have very different notions about what constitutes good behavioral functioning.

Correlations of patient–family difference scores with clinicians' direct ratings of patient self-awareness are presented in Table 8. Negative correlations in Table 8 indicate agreement between patient unawareness as measured by the difference scores and the clinician direct rating. As predicted, patient–family difference scores for general physical and cognitive areas significantly correlated with clinician rating of patient self-awareness. Correlations for behavioral and community functioning areas were in the predicted direction but failed to reach significance. As predicted, patient–family difference scores for general items correlated more strongly with clinician ratings of patient self-awareness than did patient–family difference scores for specific items. Correlations between GCS ($N = 34$) and chronicity and the patient–family difference scores and clinician rating of patient self-awareness are presented in Table 9. GCS significantly correlated with the general behavioral patient–family difference and the clinician rating of patient self-awareness. These correlations indicated that increased severity of injury was associated with poorer self-awareness. Chronicity failed to significantly correlate with any of the measures of awareness.

Table 7. Correlations between patient, family, and clinician ratings of general and community functioning

	Ratings correlated		
Area of functioning	Patient–family *r*	Patient–clinician *r*	Family–clinician *r*
Physical	.21	.01	.43***
Cognitive	.18	−.16	.14
Behavioral	.29*	−.35**	.00
Community	−.07	.08	.36**

*$p < .05$, **$p < .01$, ***$p < .001$.

Table 8. Correlations between patient–family difference scores with clinician ratings of accuracy of patient self-awareness

	Type difference score	
Area of functioning	Specific *r*	General *r*
Physical	−.10	−.36**
Cognitive	−.32*	−.42***
Behavioral	.03	−.24
Community	−	−.21

*$p < .05$, **$p < .01$, ***$p < .001$.

DISCUSSION

Results of the present studies extended and confirmed findings of previous studies regarding the nature of impaired awareness after traumatic brain injury. Our findings also provide initial evaluation of the comparability of different methods of measuring impaired awareness. In Study 1, consistent with previous studies, participants showed better awareness for physical deficits than for nonphysical (cognitive and behavioral) deficits. Also, consistent with several previous studies (e.g., Brooks et al., 1987; Brooks & McKinlay, 1983) family members reported higher levels of cognitive

Table 9. Correlations between awareness indices and severity and chronicity

Patient–Family	Severity *r*	Chronicity *r*
Differences		
General physical	−.27	.11
General cognitive	−.20	.06
General behavioral	−.34*	.23
Community functioning	−.23	.25
Specific physical	.02	−.01
Specific cognitive	−.15	.11
Specific behavioral	−.18	−.14
Clinician direct rating	.39*	.09

*$p < .05$.

https://doi.org/10.1017/S1355617798003804 Published online by Cambridge University Press

and behavioral deficits than physical deficits. Our results also extended the previous finding of Gasquoine (1992) by showing that patients are more accurate (as judged by agreement with family ratings) when rating specific descriptions of their functioning than when rating their general abilities. This result suggests that generally worded items will be more sensitive to patients' impaired self-awareness.

In Study 1, patients rated themselves as less impaired than did family members on general items. This finding is consistent with the notion that patient–family differences in general ratings of patient functioning may be indices of impaired awareness. However, Study 2 showed that clinician ratings of patient accuracy of self-awareness only partially agreed with degree of impaired awareness indicated by patient–family differences. Fordyce and Roueche (1986) have previously found that family members and clinicians differ in their ratings of patient abilities. Both these findings are consistent with Schacter and Prigatano's (1991) observation that different measures of impaired awareness are likely to produce different results. Clinicians and family members bring different frames of reference and different motivations to their assessments of patient functioning. While this is not surprising, it does have implications for the rehabilitation process. When clinicians and family members have different understandings of the patient's functioning, conflict may result and this will generally influence the patient's motivation for therapy. Prigatano et al. (1994) found that traumatic brain injury patients are more likely to have favorable productivity outcomes when the family has a good or excellent working alliance with the treatment team.

The Study 2 finding that patient–family differences on general items are more strongly related to clinician ratings of patient self-awareness than patient–family differences on specific items again suggests that generally worded items are more sensitive to impaired awareness. Our findings regarding the greater sensitivity of general items as compared to specific items to impaired awareness require additional investigation. The response demands of our general items differed from specific items as general items required participants to compare their current abilities to their preinjury abilities while specific items required participants to indicate the frequency of current difficulties. The comparison required by general items may be more threatening to patients and thus more likely to arouse a defensive or self-serving response. Alternatively, the cognitive demands of general items may be greater so that more impaired patients are less able to make such comparisons. Anderson and Tranel (1989) found that greater impairment of self-awareness was associated with lower verbal IQ and with poorer temporal orientation. Unfortunately, our data did not permit investigation of neuropsychological correlates of impaired awareness. Additional investigation in this area is needed to determine if impaired awareness is associated with general impairment of cognitive functions or associated with specific impairments such as cognitive inflexibility. While it is intuitively compelling that impaired awareness should be associated with cognitive impairment, McKinlay and Brooks (1984) and Prigatano and Altman (1990) failed to find this relation.

The exploratory analyses of the relations between severity and chronicity of injury and the awareness indices yielded few findings. The largest correlation was between clinician rating of patient self-awareness and GCS, indicating that greater severity of injury was associated with poorer self-awareness. This finding is consistent with the previous finding of Levin et al. (1987).

Our findings clearly indicate the need for additional study of the comparability of different methods for assessing impaired self-awareness. The present results indicate that these different methods can produce different results. Discrepant findings regarding the relationship between impaired awareness and long-term outcome (Ezrachi et al., 1991; Fordyce & Roueche, 1986; Walker et al., 1987) may have been partly due to using different methods to measure impaired awareness. Future studies should determine which method of measuring impaired awareness produces results that are most sensitive to change brought about by treatment and most predictive of longterm outcome. A weakness of the present study was the failure to have a control group of patients without brain injury. Allen and Ruff (1990) found that normal controls were more accurate in their self-ratings of cognitive abilities than were patients with traumatic brain injuries, but the control participants did show some tendency to overestimate their abilities. Objective measures of memory function correlate only moderately with self-ratings of memory in normal individuals (Herrmann, 1982). Future investigations of accuracy of self-awareness should include patient groups such as patients with spinal cord injuries or multiple trauma for comparison to patients with traumatic brain injuries.

ACKNOWLEDGMENTS

This work was partially supported by the US Department of Education, National Institute on Disability and Rehabilitation Research Grant No. H133A20004, awarded to The Institute for Rehabilitation and Research, Houston, TX.

The authors express their appreciation to Dr. Harvey Levin for his helpful comments on an earlier version of this manuscript, to Dr. Paula Bergloff for her assistance in the production of this manuscript, and to the staff of The Institute for Rehabilitation and Research Challenge Program for their assistance in collecting data for Study 2.

REFERENCES

Allen, C.C. & Ruff, R.M. (1990). Self-rating versus neuropsychological performance of moderate versus severe head-injured patients. *Brain Injury*, *4*, 7–17.

Anderson, S.W. & Tranel, D. (1989). Awareness of disease states following cerebral infarction, dementia, and head trauma: Standardized assessment. *Clinical Neuropsychologist*, *3*, 327–339.

Ben-Yishay, Y., Rattok, J., Piasetsky, E.B., Ross, B., Silver, S., Zide, E., & Ezrachi, O. (1985). Neuropsychologic rehabilitation: Quest for a holistic approach. *Seminars in Neurology*, *5*, 252–259.

Boake, C., Freeland, J.C., Ringholz, G.M., Nance, M.L., & Edwards, K.E. (1995). Awareness of memory loss after severe closed-head injury. *Brain Injury*, *9*, 273–283.

Brooks, D.N., & McKinlay, W. (1983). Personality and behavioural change after severe blunt head injury: A relative's view. *Journal of Neurology, Neurosurgery, and Psychiatry*, *46*, 336–344.

Brooks, N., Campsie, L., Symington, C., Beattie, A., & McKinlay,W. (1987). The effects of severe head injury on patient and relative within seven years of injury. *Journal of Head Trauma Rehabilitation*, *2*, 1–13.

Damasio, A.R. & Anderson, S.W. (1993). The frontal lobes. In K.M. Heilman & E. Valenstein (Eds.), *Clinical neuropsychology* (3rd ed.; pp. 409–460). New York: Oxford University Press.

Ezrachi, O., Ben-Yishay, Y., Kay, T., Diller, L., & Rattok, J. (1991). Predicting employment in traumatic brain injury following neuropsychological rehabilitation. *Journal of Head Trauma Rehabilitation*, *6*, 71–84.

Fleming, J.M., Strong, J., & Ashton, R. (1996). Self-awareness of deficits in adults with traumatic brain injury: How best to measure. *Brain Injury*, *10*, 1–15.

Fordyce, D.J. & Roueche, J.R. (1986). Changes in perspectives of disability among patients, staff, and relatives during rehabilitation of brain injury. *Rehabilitation Psychology*, *31*, 217–229.

Gasquoine, P.G. (1992). Affective state and awareness of sensory and cognitive effects after closed head injury. *Neuropsychology*, *4*, 187–196.

Gasquoine, P.G. & Gibbons, T.A. (1994). Lack of awareness of impairment in institutionalized, severely and chronically disabled survivors of traumatic brain injury: A preliminary investigation. *Journal of Head Trauma Rehabilitation*, *9*, 16–24.

Godfrey, G.P.D., Partridge, F.M., Knight, R.G., & Bishara, S. (1993). Course of insight disorder and emotional dysfunction following closed head injury: A controlled cross-sectional follow-up study. *Journal of Clinical and Experimental Neuropsychology*, *15*, 503–515.

Goldstein, K. (1939). *The organism*. New York: American Book Co.

Heaton, R.K. & Pendleton, M.G. (1981). Use of neuropsychological tests to predict adult patients' everyday functioning. *Journal of Consulting and Clinical Psychology*, *49*, 807–821.

Heilbronner, R.L., Roueche, J.R., Everson, S.A., & Epler, L. (1989). Comparing patient perspectives of disability and treatment effects with quality of participation in a post-acute brain injury rehabilitation programme. *Brain Injury*, *3*, 387–395.

Heilman, K.M., Watson, R.T., & Valenstein, E. (1993). Neglect and related disorders. In K.M. Heilman & E. Valenstein (Eds.), *Clinical neuropsychology* (3rd ed.; pp. 279–336). New York: Oxford University Press.

Hendryx, P.M. (1989). Psychosocial changes perceived by closed-head-injured adults and their families. *Archives of Physical Medicine and Rehabilitation*, *70*, 526–530.

Herrmann, D.J. (1982). Know thy memory: The use of questionnaires to assess and study memory. *Psychological Bulletin*, *92*, 434–452.

Levin, H.S., High, W.M., Goethe, K.E., Sisson, R.A., Overall, J.E., Rhoades, H.M., Eisenberg, H.M., Kalisky, Z., & Gary, H.E., (1987). The neurobehavioural rating scale: Assessment of the behavioural sequelae of head injury by the clinician. *Journal of Neurology, Neurosurgery, and Psychiatry*, *50*, 183–193.

McGlynn, S.M. & Schacter, D.L. (1989). Unawareness of deficits in neuropsychological syndromes. *Journal of Clinical and Experimental Neuropsychology*, *11*, 143–205.

McKinlay, W.W. & Brooks, D.N. (1984). Methodological problems in assessing psychosocial recovery following severe head injury. *Journal of Clinical Neuropsychology*, *6*, 87–99.

Priddy, D.A., Mattes, D., & Lam, C.S. (1988). Reliability of self report among non-oriented head-injured adults. *Brain Injury*, *2*, 249–253.

Prigatano, G.P. (1996). Behavioral limitations TBI patients tend to underestimate: A replication and extension to patients with lateralized cerebral dysfunction. *Clinical Neuropsychologist*, *10*, 191–201.

Prigatano, G.P. & Altman, I.M. (1990). Impaired awareness of behavioral limitations after traumatic brain injury. *Archives of Physical Medicine and Rehabilitation*, *71*, 1058–1064.

Prigatano, G.P., Altman, I.M., & O'Brien, K.P. (1990). Behavioral limitations that brain injured patients tend to underestimate. *Clinical Neuropsychologist*, *4*, 163–176.

Prigatano, G.P. & Fordyce, D.J. (1986). Cognitive dysfunction and psychosocial adjustment after brain injury. In G.P. Prigatano, D.J. Fordyce, H.K. Zeiner, J.R. Roueche, M. Pepping, & B.C. Wood (Eds.), *Neuropsychological rehabilitation after brain injury* (pp. 1–17). Baltimore: Johns Hopkins University Press.

Prigatano, G.P., Fordyce, D.J., Zeiner, H.K., Roueche, J.R., Pepping, M., & Wood, B.C. (Eds.). (1986). *Neuropsychological rehabilitation after brain injury*. Baltimore: Johns Hopkins University Press.

Prigatano, G.P., Klonoff, P.S., O'Brien, K.P., Altman, I.M., Amin, K., Chiapello, D., Shepherd, J., Cunningham, M., & Mora, M. (1994). Productivity after neuropsychological oriented milieu rehabilitation. *Journal of Head Trauma Rehabilitation*, *9*, 91–102.

Ranseen, J.D., Bohaska, L.A., & Schmidt, F.A. (1990) An investigation of anosognosia following traumatic head injury. *International Journal of Clinical Neuropsychology*, *12*, 29–36.

Romano, M.D. (1974). Family response to traumatic head injury. *Scandinavian Journal of Rehabilitation Medicine*, *6*, 1–4.

Schacter, D.L. & Prigatano, G.P. (1991). Forms of unawareness. In G.P. Prigatano & D.L. Schacter (Eds.), *Awareness of deficit after brain injury: Clinical and theoretical issues* (pp. 258–262). New York: Oxford University Press.

Stuss, D.T. (1991). Disturbance of self-awareness after frontal system damage. In G.P. Prigatano & D.L. Schacter (Eds.), *Awareness of deficit after brain injury: Clinical and theoretical issues* (pp. 63–83). New York: Oxford University Press.

Teasdale, G. & Jennett B. (1974). Assessment of coma and impaired consciousness. *Lancet*, *2(7872)*, 81–84.

Walker, D.E., Blankenship, V., Ditty, J.A., & Lynch, K.P. (1987). Prediction of recovery for closed-head-injured adults: An evaluation of the MMPI, the Adaptive Behavior Scale, and a "Quality of Life" Rating Scale. *Journal of Clinical Psychology*, *43*, 699–707.

Weinstein, E.A. & Kahn, R.L. (1955). *Denial of illness*. Springfield, IL: Charles Thomas.