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Lateralization of Deficit in Self-Awareness of Memory in Patients with Intractable Epilepsy

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Summary: *Purpose:* Memory disorders are prominent among patients with intractable epilepsy. It has, however, been frequently observed that subjective memory complaints of these patients did not match their performance on objective memory tests. This discrepancy may reflect emotional, cognitive, or self-awareness deficits among these individuals. The aim of the current study was to explore the interference of cerebral dysfunction on accuracy of self-appraisal for memory.

Methods: The degree of concordance between self-perception of memory function, as measured by a visual analogue scale, and actual performance on memory tests was computed in 35 patients who were candidates for epilepsy surgery and demographically matched normal control subjects. The difference between the self-estimated memory ability and performance on memory tests and its relation to the laterality of an epileptogenic lesion, cognitive factors, and affective status was then examined.

Results: The results show that the discrepancy between the self-estimated memory ability and performance on memory tests in patients with right hemisphere epileptogenic lesions was significantly larger in magnitude compared with that in patients with left hemisphere lesions and demographically matched control subjects ($p = 0.001$). Furthermore, whereas patients with left hemisphere lesions and normal controls had about an equal number of positive and negative discrepancy scores, all patients with right hemisphere lesions had positive discrepancy scores, suggesting a tendency for overestimation of memory abilities.

Conclusions: These results suggest that right hemisphere lesions may introduce a systematic bias in self-awareness for memory. This bias may color patients' perceptions of self and others, affecting their perceptions of the quality of life, and necessitating an adjustment of the treatment goals and procedures. **Key Words:** Self-awareness—Memory—Lateralization—Epilepsy surgery.

Memory disorders are the most common consequence of brain lesions, particularly in patients with intractable, most frequently temporal lobe epilepsy condition, which often results from damage to the medial temporal areas (1). Memory complaints that frequently accompany memory disorders are reportedly related not only to patients' memory performance but also to their awareness of the memory capabilities (2–4).

Self-awareness is considered a high-level brain function and is defined as an interface between objective and subjective elements of human perceptions (5). Brain damage can significantly affect self-awareness in general and self-awareness of one's memory functioning in particular (3). The phenomenon of deficient self-awareness has been previously described as anosognosia: the denial of illness (6) and lack of insight regarding cognitive and behavioral disorders (3), including memory disorders (7).

The findings of studies on self-awareness of memory performed among other neurologic patient populations suggest that this function may be related to a variety of cognitive and emotional variables (8–10). Janowsky et al. (11), in their study with patients with amnesia, found that some patients expressed adequate self-awareness of their memory capabilities, whereas others did not, regardless of the extent of their actual memory impairment. Other studies suggest that reduced memory self-awareness may be related to affective status (e.g., depression) (2,4,12), lateralized emotional deficits (13,14), or frontal lobe dysfunction (15–17).

Lateralization of affect and its relation to self-awareness has been addressed by many authors (e.g., 18–20). Some reports suggest that anxiety is a common feature of left hemisphere involvement that may be expressed as oversensitivity to the impairments, exaggeration of disabilities,

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and "catastrophic reactions" (13). In contrast, patients with right hemisphere lesions are less likely to be aware of their mistakes, tend to diminish the extent of their disabilities, and sometimes show an attitude of "la belle indifference" (13). These tendencies may contribute to bias in self-awareness.

Although numerous studies had been performed on memory deficits in patients with epilepsy, few were done on self-awareness of memory in this population (7,21–26). Bear and Fedio (23) reported that compared with their family reports, temporal lobe epilepsy patients with left hemisphere lesions tended to exaggerate their memory symptoms, whereas patients with right hemisphere lesions tended to underestimate them. When subjective memory complaints were compared with performance on objective memory tests, however, no statistical differences emerged. Prevey et al. (24) and Breier et al. (25) studied individual perceptions of memory abilities in epilepsy patients and found that patients with either left or right temporal lobe seizures overestimated their memory capacities in comparison with normal controls. By contrast, Piazzini et al. (7) reported that patients with epilepsy underestimated their memory abilities compared with their performance on formal tests. Finally, Thompson (1) and Corcoran and Thompson (26) found that temporal lobe epilepsy patients with left hemisphere epileptogenic lesions tended to complain more about their memory and used more mnemonic devices than did patients with right hemisphere epileptogenic lesions. These reports suggest a possibility of a differential effect of laterality on memory self-awareness.

The importance of neuropsychological studies of patients' memory complaints lies in their ability to elucidate the construct of self-awareness and its neurologic correlates. The clinical significance of these studies is its relevance to patients' perceptions of their quality of life and everyday functioning. It is well known that deficient self-awareness can significantly interfere with psychosocial adaptation of patients with brain lesions (27). Understanding lateralized differences in self-awareness may significantly affect treatment goals and procedures with these patients.

The present study systematically examined how the left- and the right-lateralized hemisphere dysfunction interfered with patients' perceptions of their memories. The difference between self-estimated memory abilities and actual performance on memory tests (discrepancy scores) in patients with epilepsy was measured and its relation to anxiety and depression was explored to investigate the lateralization effect in self-awareness of memory. Our hypothesis, based on the review of lateralization studies, was that if qualitative differences in self-awareness for memory exist between the two patient groups, they would be reflected in the directionality and magnitude of the discrepancy scores. Specifically, patients with left hemisphere lesions (LH) would underestimate, while the patients with right hemisphere lesions (RH) would overestimate their memory abilities, compared with their actual performance on memory tests.

METHODS

This was a 2-year prospective study whose aim was to investigate the relations between the laterality of an epileptogenic lesion, self-perception of memory function, performance on objective memory tests, and affective status in candidates for epilepsy surgery.

Subjects

All patients who participated in this study were candidates for unilateral surgical resection of epileptic focus for control of intractable seizures at the Tel Aviv Sourasky Medical Center. There were 17 patients with LH epilepsy (11 male and six female patients; mean age, 27.94 ± 10.57 years) and 18 patients with RH epilepsy (11 male and seven female patients; mean age, 30.11 ± 7.02 years). In addition, 17 control subjects (NC) matched for age, sex, and educational level participated in the study (11 male and six female controls; mean age, 31.88 ± 10.65 years). The following selection criteria were applied to the two patient groups: (a) unilateral epileptogenic zone, (b) age range between 18 and 65 years, (c) at least 8 years of education, (d) no history of psychiatric disorders or substance abuse, and (e) no mental retardation. Most of the patients (29 of 35) had complex partial seizures with or without secondary generalization. The laterality of the epileptogenic zone was determined by concordant results of video-EEG monitoring and magnetic resonance imaging (MRI). Sixteen patients had undergone Wada testing to determine their cerebral language dominance and unilateral memory potential. All the patients underwent extensive presurgical neuropsychological examinations that included measures of general intelligence, memory, perception, language, motor, and executive functions, as well emotional status. Statistical analysis performed on the demographic variables showed that no significant differences existed between the three subject groups. The patients' characteristics are presented in Tables 1 and 2.

Measures

Self-rating scales

A visual analogue scale (VAS) was used for self-assessment of memory. It included a 10-point Likert scale, 100 mm in length, with each pole representing extremes in symptoms (28). Each subject was asked to provide an overall rating of his memory on a scale of 0 to 100, with 0 referring to "the worst possible memory," whereas 100 referred to the "best possible memory." The VAS scales have been reported to have good indexes of validity and reliability (29). This subjective measure was given to the subjects before the standard memory tests were administered, with the intent of documenting the

TABLE 1. *Characteristics of patients with left hemisphere epileptic focus*

Patient no.	Gender	Age (yr)	Hand dominance	Education (yr)	Language dominance (Wada)	MRI	Age at seizure onset (yr)	Types of seizures
1	M	18	Right	12	–	Temporal cavernoma	16	SPS
2	M	34	Right	12	–	Mesial temporal sclerosis	27	CPS
3	M	41	Right	15	Left	Mesial temporal sclerosis	31	CPS
4	F	22	Right	13	Left	Mesial temporal sclerosis	1	CPS
5	F	22	Right	14	Left	Temporal cyst	8	CPS
6	M	42	Right	16	Left	Mesial temporal sclerosis	18	CPS w/SGTCS
7	M	23	Right	12	Left	Mesial temporal sclerosis	9	CPS
8	M	18	Right	12	–	Temporal low-grade glioma	7	CPS
9	M	32	Right	12	Left	Temporal low-grade glioma	0.5	CPS
10	F	49	Right	12	–	Mesial temporal sclerosis	19	CPS
11	M	35	Left	12	–	Frontal cortical dysplasia	4	CPS w/SGTCS
12	M	23	Right	12	–	Frontal low-grade glioma	14	CPS w/SGTCS
13	M	42	Right	10	–	Mesial temporal sclerosis	6	CPS
14	F	19	Right	13	–	Temporal cyst	3	CPS
15	M	20	Right	12	–	Temporal cavernoma	18	CPS
16	F	18	Right	12	–	Frontal cortical dysplasia	9	SPS
17	F	18	Right	12	–	Temporal vascular malformation	14	CPS

CPS, complex partial seizure; SGTCS, secondarily generalized tonic–clonic seizure; SPS, simple partial seizure.

subjects' own perceptions of their day-to-day memory functioning.

Neuropsychological assessment

The following measures of general cognitive and memory functioning were used as part of a comprehensive preoperative neuropsychological assessment. Wechsler Adult Intelligence Scale–Revised (30) as a measure of general intelligence and verbal and performance IQs. The Visual Reproduction (VR) subtest of the Wechsler Memory Scale (31), immediate and delayed recall, and the Warrington Face Recognition Test (32) were used as measures of visual memory. The Rey Auditory Verbal Learning Test (33) and the Verbal Paired Associates (VPA) of the Wechsler Memory Scale, immediate and delayed recall, were used as measures of verbal memory.

Affective status examination

Two measures of affect were used. The Spielberger Questionnaire of State/Trait Anxiety (34) was used to explore the level of anxiety. This questionnaire consists of 20 questions pertaining to "state" (situational) anxiety and 20 questions pertaining to "trait" (personality feature) anxiety. The questionnaire uses a 4-point Likert-scale format for rating the degree of anxiety. The Geriatric Depression Inventory (GDI) (35) was used to assess the level of depression. This questionnaire consists of 30 questions with a yes/no format. The mean depression score computed for

TABLE 2. *Characteristics of patients with right hemisphere epileptic focus*

Patient	Gender	Age (yr)	Hand dominance	Education (yr)	Language dominance (Wada)	MRI	Age at seizure onset (yr)	Types of seizures
1	M	34	Right	15	Left	Mesial temporal sclerosis	8	CPS
2	M	28	Left	12	Left	Frontal cortical dysplasia	13	SPS w/SGTCS
3	F	24	Left	12	Right	Mesial temporal sclerosis	12	CPS
4	M	25	Right	11	Left	Mesial temporal sclerosis	5	SPS w/SGTCS
5	M	36	Right	12	Right	Mesial temporal sclerosis	17	CPS
6	F	31	Right	10	Left	Mesial temporal sclerosis	14	CPS
7	M	23	Right	12	–	Temporal cavernoma	22	SPS
8	M	26	Right	15	–	Temporal encephalomalacia	4	CPS, SPS
9	M	25	Right	12	–	Temporal traumatic injury	10	SPS
10	M	32	Right	12	–	Temporal encephalomalacia	10	CPS w/SGTCS
11	F	24	Right	12	Left	Temporal dysplasia	16	CPS
12	F	25	Left	12	Bilateral	Mesial temporal sclerosis	20	CPS
13	M	41	Right	12	Left	Mesial temporal sclerosis	1	CPS w/SGTCS
14	F	27	Right	13	–	Temporal astrocytoma	24	CPS
15	F	45	Right	12	–	Mesial temporal sclerosis	6	CPS
16	M	30	Right	12	–	DNET	12	CPS w/SGTCS
17	M	24	Right	12	–	Temporal gliosis	6	CPS w/SGTCS
18	F	43	Right	14	Left	Temporal cavernoma	13	CPS

CPS, complex partial seizure; SGTCS, secondarily generalized tonic–clonic seizure; SPS, simple partial seizure; DNET, dysembryoplastic neuroepithelial tumor.

each subject was used for statistical analysis. The GDI, rather than the Beck Depression Inventory was used because of lack of patient cooperation on the latter measure: many patients either refused to answer the questions or answered them in a very defensive manner.

Measures of memory self-awareness

To ensure comparability among all measures, the normally distributed raw scores were rescaled to standard equivalents (z transformations) by using the means and standard deviations from the normal control group: z-score $= (x - \overline{x})/\sigma$, where x refers to any specific score of the objective or subjective tests in LHs and RHs, $\overline{x}$ refers to the mean test scores of the normal control group, and σ is its standard deviation (36). We assumed that normal control subjects would not rate their memory as "perfect," so that the discrepancy score of the normal control subjects could serve as a standard for comparison with patients. The measure of general memory self-awareness refers to the discrepancy between the subject's self-reported memory scaled score (VAS) and his overall composite performance scaled score of the long-term recall on verbal paired associates and visual reproduction subtests of the WMS-R. In addition, VAS memory scores were compared with measures of verbal (VPA) and visual (VR) memory separately, resulting in distinct visual and verbal memory self-awareness scores.

The value of the difference between these measures was negative if the self-perceived memory z-score was lower than the actual memory performance z-score, reflecting a negative bias (underestimation) in self-awareness. It was positive if the self-perceived memory z-score was higher than that of the actual memory performance, reflecting a positive bias (overestimation) in self-awareness.

Statistical analysis

Analysis of variance (ANOVA) followed by planned comparisons was performed to determine whether the subject groups (LH, n = 17; RH, n = 18; NC, n = 17) differed on the measures of memory and affect. χ^2 and Fisher's exact test analyses were performed on measures of self-awareness to determine whether the directionality of the discrepancy values differed according to subject groups.

RESULTS

Memory self-awareness discrepancy scores

The group means of the VAS (self-rating) scores were not statistically significant. The VAS scores were contrasted with the general memory, verbal memory, and visual memory test scores, and the resulting discrepancy scores were analyzed in terms of directionality and magnitude.

Directionality of the discrepancy scores

The discrepancy scores were divided into three groups. The first group included z-values that ranged between –1.0 and +1.0. These values reflected "balanced" self-awareness, in which the gap between the self-estimated and actual memory performance was smaller than 1 standard deviation from the mean (defined as a discrepancy score equal to 0). The second group included z-values higher than +1.0. These discrepancy scores were defined as "overestimation" discrepancy scores (i.e., they reflected significantly higher self-rated memory than the actual performance on memory tests). The third group included z-values below –1.0, which were defined as "underestimation" discrepancy scores. These values reflected a significantly lower self-estimated than the actual memory performance. The second and the third groups included values that reflected significant discrepancies of possible clinical importance relative to the construct of a deficit in self-awareness. The frequency of these discrepancies was then tested for an association with lateralized brain dysfunction. χ^2 analysis was performed to compare the distribution of patients with "over-" and "underestimation" discrepancy score values in the two patient groups. Table 3 displays the distribution of patients with the discrepancy scores whose values were outside the range of 1 standard deviation from the mean. As can be seen from Table 3, all patients with right hemisphere dysfunction had positive discrepancy scores on all measures of memory self-awareness. Patients with left hemisphere dysfunction, conversely, showed about an equal number of positive and negative discrepancy scores on memory self-awareness measures.

The χ^2 analysis that was performed to determine the difference in proportion of positive and negative discrepancy scores within the LH group of patients did not yield statistically significant results. Moreover, the proportion of positive and negative discrepancy scores in the LH group did not significantly differ from that of the NC group. In contrast, a significantly high proportion of positive to negative discrepancy scores was found in the RH group ($p = 0.0001$). Fisher's exact test rather than the χ^2 analysis was

TABLE 3. *Distribution of subjects with overestimation and underestimation discrepancy scores on measures of memory self-awareness*

	Focus of lesion	Direction of discrepancy score	
		Positive	Negative
Self-awareness	RH	14/14	0/14
for verbal memory	LH	7/14	7/14
(n = 28 patients)	NC (n = 3)	2/3	1/3
Self-awareness	RH	13/13	0/13
for visual memory	LH	7/14	6/14
(n = 27 patients)	NC (n = 5)	3/5	2/5
Self-awareness	RH	15/15	0/15
for general memory	LH	6/10	4/10
(n = 25 patients)	NC (n = 5)	3/5	2/5

LH, left hemisphere epilepsy; RH, right hemisphere epilepsy; NC, normal control subjects.

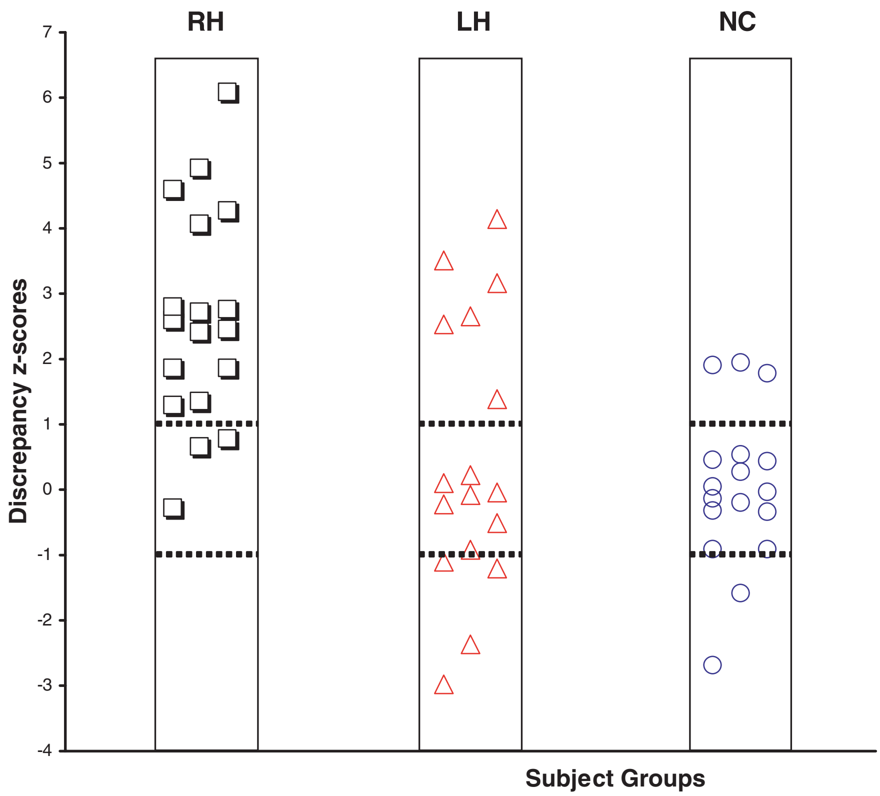

FIG. 1. The relative difference in the distribution of the directionality of the discrepancy z-scores by the three subject groups. *RH* (*squares*), 18 patients with right hemisphere epileptogenic lesions; *LH* (*triangles*), 17 patients with left hemisphere epileptogenic lesions; *NC* (*circles*), 17 demographically matched normal control subjects. The data points are ordered within each group into three arbitrary columns for presentation purposes. The tendency by *RH* patients to overestimate their memory abilities, compared with *LH* patients and *NC* subjects, can be seen. The region between the two *dashed lines* corresponds to the upper and lower boundaries of the "balanced" self-awareness.

performed on the values of RH patient group because these values constituted a dichotomous rather than a continuous variable. Analysis of the discrepancy score distribution performed on all patients showed similar results (Fig. 1).

Magnitude of discrepancy scores analysis

Because no significant differences in the proportion of positive to negative discrepancy scores were found in LH and NC groups, an additional analysis of variance was performed on the *absolute* values of the discrepancy scores disregarding their directionality. The magnitude of difference between the self-perceived memory z-score and the actual memory z-score reflects the extent of the gap between the patients' performance from that of the NC group. One-way ANOVA performed on the mean absolute values of the discrepancy scores between all subject groups yielded significant results on the verbal ($p = 0.001$), visual ($p = 0.003$), and general ($p = 0.001$) memory self-awareness measures (Table 4). A post hoc Bonferroni pairwise comparisons analysis showed that the only significant contrast was between the NC and the RH group, on all measures (verbal memory self-awareness, $p = 0.001$; visual memory self-awareness, $p = 0.003$; general memory self-awareness, $p = 0.003$).

Memory test scores

ANOVA followed by multiple comparisons was performed to determine whether the subject groups differed in performance on the measures of visual and verbal memory. Table 5 displays the mean scores for each memory measure by group classification. Higher scores reflect better memory performance. The main effect was significant for all visual memory measures. Pair-wise comparisons revealed that LH patients did significantly better than RH patients on two measures of visual memory (Warrington, $p = 0.02$; VR LTM, $p = 0.01$). In addition, the patient groups significantly differed from the NC group on all visual memory measures (Warrington, $p = 0.001$; VR STM, $p = 0.003$; VR LTM, $p = 0.001$). The analysis of contrast between NC and LH subjects did not yield significant differences.

Material-specific memory deficits were not found with the verbal memory measures (Table 5). Significant differences were found among subject groups on the long-term recall of the Rey Auditory Verbal Learning Test (RAVLT) ($p = 0.02$), the VPA WMS short-term ($p = 0.04$) test and

TABLE 4. *Mean absolute values of memory discrepancy scores in subject groups*

	Verbal memory	Visual memory	General memory
LH (n = 17)	1.70 (±1.67)	2.18 (±1.93)	1.59 (±1.36)
RH (n = 18)	2.70 (±1.71)	2.74 (±1.67)	2.66 (±1.59)
NC (n = 17)	0.68 (±0.58)	0.89 (±0.85)	0.86 (±0.80)

LH, left hemisphere epilepsy; RH, right hemisphere epilepsy; NC, normal control subjects.

TABLE 5. *Mean scores for each memory measure by subject group*

	LH	RH	NC	F	p Value
Rey 1	6.88 ± 1.41	6.17 ± 1.98	6.59 ± 1.28	0.89	0.42
Rey Total	49.53 ± 9.79	44.72 ± 9.43	48.18 ± 8.31	1.28	0.29
Rey 8	8.35 ± 4.36	6.89 ± 3.45	10.41 ± 3.00	4.12	0.02
VPA STM	18.06 ± 5.4	14.83 ± 4.64	18.71 ± 4.06	3.39	0.04
VPA LTM	5.77 ± 2.46	4.50 ± 1.98	7.00 ± 1.12	7.30	0.002
Warrington	40.65 ± 5.30	36.06 ± 5.73	42.71 ± 5.19	6.94	0.002
VR STM	34.24 ± 5.47	30.61 ± 6.74	36.41 ± 3.66	5.04	0.010
VR LTM	27.35 ± 13.20	18.17 ± 8.97	33.58 ± 5.23	11.27	0.000

LH, left hemisphere epilepsy; RH, right hemisphere epilepsy; NC, normal controls; F, F statistic of analysis of variance; Rey 1, number of words recalled after first trial on the Rey Auditory Verbal Learning Test (RAVLT); Rey Total, number of words recalled on the first five trials of RAVLT; Rey 8, number of words recalled on the delayed-recall trial; VPA STM, number of words recalled on the first three trials of the paired associate learning subtest of the Wechsler Memory Scale Revised; VPA LTM, number of words recalled on the delayed trial of the paired associate learning subtest of the Wechsler Memory Scale–Revised; Warrington, Warrington Face Memory Test; VR STM, immediate visual reproduction of the Wechsler Memory Scale–Revised; VR LTM, delayed visual reproduction recall of the Wechsler Memory Scale.

the long-term recall ($p = 0.002$) test. Pair-wise comparisons showed that the LH group performed significantly better than the RH group on the short-term recall of paired associates ($p = 0.05$). The NC group tended to perform better than the patient groups on the long-term recall of pair associates ($p = 0.07$). The post hoc multiple comparisons revealed that the main difference on the Rey delayed recall and on the WMS pair associate learning test was between the NC and the RH groups (Rey 8, long-term recall, $p = 0.01$; VPA STM, $p = 0.04$; VPA LTM, $p = 0.001$), which explains the significant results of the ANOVA.

Affect scores

ANOVA was performed to determine whether subject groups differed on measures of anxiety and depression. Table 6 displays the mean score of depression and each anxiety measure according to subject group. Higher scores reflect higher levels of negative affect. Contrary to our expectations, no significant differences were found between the two patient groups on measures of depression as well as on measures of total, state, and trait anxiety. Pair-wise comparison analysis revealed that both, the LH and the RH patients were significantly more anxious and more depressed than the NC group on all measures.

DISCUSSION

The data of this study suggest that patients with intractable epilepsy experience significant distortions in their awareness of memory. However, a difference was noted in the valence of this distortion as a function of laterality. The findings suggest that patients with right hemisphere epileptogenic lesions tend to overestimate their memory performance, whereas patients with left hemisphere epileptogenic lesions demonstrate a somewhat equal distribution of under- and overestimation of memory, similar to that of normal control subjects. In addition to these qualitative differences, a quantitative difference was seen between RH and LH patients' memory self-appraisal. The magnitude of difference between the self-perceived and the actual memory (the z-score) was significantly higher for RH, as compared with LH and NC. These results suggest that, on a group level, impaired self-awareness seems to be associated predominantly with right hemisphere dysfunction.

The results of this study are consistent with the data of Bear and Fedio (23), who reported that patients with right temporal lobe epilepsy tend to overestimate their abilities and to underestimate their deficits compared with their family report. Our findings suggest that this observation

TABLE 6. *Mean scores for measures of depression and anxiety by subject group*

	LH	RH	NC	F	p Value
GDS	0.39 ± 0.24	0.34 ± 0.21	0.13 ± 0.12	8.23	0.001
Total Anxiety	2.19 ± 0.59	2.18 ± 0.41	1.67 ± 0.23	8.08	0.001
State Anxiety	2.09 ± 0.66	2.08 ± 0.56	1.62 ± 0.36	4.13	0.022
Trait Anxiety	2.28 ± 0.57	2.28 ± 0.37	1.71 ± 0.27	10.47	0.000

LH, left hemisphere epilepsy; RH, right hemisphere epilepsy; NC, normal controls; F, F statistic of analysis of variance; GDS, mean group depression score on the Geriatric Depression Inventory, range 0 to 1; Total Anxiety, mean group total anxiety score on the Spielberger State/Trait Anxiety Scale; State Anxiety, mean group state anxiety score on the Spielberger State/Trait Anxiety Scale; Trait Anxiety, mean group trait anxiety score on the Spielberger State/Trait Anxiety Scale.

is correct also when the self-report of these patients is compared with their performance on objective tests. The data were not supportive of material specificity of memory self-awareness in epilepsy patients, as reported in Prevey et al. (24). Our results suggest that the distortions and bias that may be caused by right hemisphere dysfunction is a global feature, not related to affective status (4) or to cognitive abilities. This bias, apparently neurologic in nature, may color patients' self-perceptions, including self-perceptions of memory, and affect their quality of life, as shown in our previous study (37).

Despite an absence of significant correlations between the discrepancy scores and the affective measures in this study, a tendency for patients with right lesions to show positive affectivity and some disregard for their deficits was observed during clinical testing. These observations agree with the literature reports on lateralization of affect (13,14) and seem to support indirectly the trend of patients with right hemisphere epileptogenic lesions to overestimate their memory abilities.

The unexpected finding of this study was that the LH patients, as a group, performed better than the RH patients on verbal memory tests, rather than showing material specific memory deficits observed in many studies with epilepsy patients. Several alternative explanations may be found for this result. They may be related to a slightly greater, although not statistically significant, overall cognitive impairment demonstrated by the patients with RH lesions that may have been correlated with lower performance on memory tests. Alternatively, they may be related to more severe epilepsy of RH patients, despite an absence of significant differences in the medication burden between the two groups. As can be seen in Tables 1 and 2, six RH as opposed to only three LH patients had epilepsy with secondary generalization. However, the most plausible explanation of these findings seems to be the relative heterogeneity of the two patients groups, which included not only patients with mesial temporal sclerosis but also patients with neocortical temporal pathology. Material-specificity of memory dysfunction has been associated predominantly with unilateral hippocampal dysfunction and not necessarily with neocortical lesions (38).

Several methodologic problems in this research should be mentioned. A basic assumption of the present study was that the discrepancy score between the self-estimated general memory function and the actual performance on memory tests reflected self-awareness. A potential problem with this assumption was that a deficit in self-awareness was inferred indirectly by the discrepancy between a single global rating of one's memory function and performance on multiple specific memory tests. To overcome this difficulty, an overall memory composite score as well as composite verbal and visual memory scores were computed to contrast with the global self-rating scale. Despite their limitations, the composite scores were considered to be more reliable measures of memory performance.

Self-report measures have a potential limitation as well. Self-perceptions of memory, affect, and quality of life have been previously assessed by self-report measures, such as self-rating scales or VAS (4,22,29). The studies that examined the correlation between the self-report memory measures and actual performance on standardized memory tests, however, found them to have a rather moderate relation (39,40). Hertzog et al. (40) suggested that adults appear to overestimate their memory capabilities because of their deficient memory and not meta-memory. The reason for this overestimation is proposed to be a tendency of most adults to use the middle of the rating scale when predicting their memory performance but actually perform at a below-average level on the tests of memory. As such, deficits in predictive accuracy of adults seem to be an artifact of scaling. The present study accounts for the possibility of central tendencies in self-rating by performing an analysis of the frequency distribution of z-scores that were outside the "central" range. The results clearly show that both RH and LH patients demonstrate a significant gap between the self-estimated memory abilities and the actual performance on memory measures. However, the significant positive distribution and the larger magnitude of RH patients' discrepancy scores, compared with patients with left lesions and normal controls, suggest a strong tendency for overestimation and reflect a possible neurologically based bias in perception of self.

In summary, the results of the present study suggest that overall patients with localization-related epilepsy demonstrate distortions in self-assessment of their memory, not directly related to their cognitive and affective status. The distortions in self-appraisals were more prominent in patients with RH epileptogenic lesions, who significantly overestimated their memory functioning. These results underscore the existence of bias in self-awareness associated with unilateral and particularly RH epileptogenic lesions that should be taken into account in presurgical patient counseling. It is recommended that future studies on deficit in self-awareness of memory be carried out on a large sample of patients with epilepsy, preferably with mesial temporal sclerosis.

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