Linguistic Impairment in Closed Head Injured Patients: The Role of the Clinical Aphasiologist in Assessment and Treatment

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INTRODUCTION

Differential diagnosis of neuropathologies has been a growing concern of aphasiologists, yet few empirical studies have addressed this issue (Wertz, 1978). With recent advances in emergency medicine and neurosurgery, the survival rate of patients who have sustained a closed head injury is increasing. Consequently, there is a growing population which challenges the aphasiologist to render accurate differential diagnosis and may pose a dilemma when focusing language treatment. Clinical examination during the early phases of recovery from closed head injury has disclosed that all patients who have experienced coma suffer a significant degree of verbal and cognitive impairment (Sarno, 1981). Considerable disagreement exists in the literature regarding the nature of linguistic deficits resulting from closed head injury (Groher, 1977). The language behavior of these patients is most often described as confabulatory and irrelevant (Carley, 1969; Halpern, Darley and Brown, 1973; Wertz, 1978; Hagen, 1979; and Malkmus, 1980) and has been categorized as "the language of confusion" (Halpern, Darley and Brown, 1973; Wertz, 1978). Labels such as anomic aphasia (Heilman et al., 1971; Levin et al., 1976; Groher, 1977); amnestic aphasia (Kriendler et al., 1975; Thomsen, 1975; 1976); subclinical aphasia (Sarno, 1980); verbal paraphasia (Thomsen, 1975; Groher, 1977); and Wernicke's aphasia (Heilman et al., 1971) have also been assigned when linguistic deficits have been viewed as isolated phenomena. For closed head injured patients who exhibit diffuse damage, confusion and cognitive impairment may be predominant with language impairment reflecting underlying cognitive disorganization (Hagen, 1979; 1981).

Because linguistic and cognitive functions are particularly vulnerable in closed head injury, these factors should be taken into account in patient evaluation and management. Traditional aphasia batteries typically do not reveal the subtle linguistic difficulties exhibited by closed head injured patients (Thomsen, 1980). Sarno (1981) discussed the importance of recognizing the qualitative details which distinguish these patients from each other and from other patients with verbal impairment secondary to brain damage. The boundaries which usually help to identify and classify patients with linguistic deficits following brain damage do not seem to hold to the same degree for the head trauma patient as they do in the stroke population.

Although word association and retrieval skills are often defective in both the closed head injured and aphasic populations, they receive only passing attention in most standardized language examinations. Tests for word retrieval difficulties usually involve visual confrontation naming in which the patient is asked to name pictures or objects presented to him. Goodglass and Kaplan, as cited by Wertz (1978), cautioned against the use of visual confrontation naming alone as an index of the patient's word-finding difficulties. It has been documented that closed head injured patients who remain comatose for long periods often exhibit visual disturbances (Sarno and Sarno, 1969). It would appear then, that visual

confrontation naming is not an effective measure of these patients' word retrieval and association skills.

The SORRT (Semantic, Oppositional, Rhyming Retrieval Training) procedure developed by Logue and Dixon (1977) is a sensitive tool which has been used to detect word association and retrieval deficits in aphasic and right-hemisphere impaired patients (Dixon, 1977; Logue and Dixon, 1977; 1978; 1979; Toler, 1980; and Malcolm, 1981). It has a neurolinguistic base evolving from an attempt to develop a clinical application model integrating the theoretical postulates of Jacobson (1956) with the more recent studies of Cermak and Moreines (1976), Cermak, Naus and Reale (1976) and Marshall (1976) on retrieval functions in brain damaged adults. SORRT utilizes word association to explore the assumption that verbal information, in particular a single isolated word, is remembered on the basis of its distinctive phonemic, semantic and conceptual features. The program relies heavily on semantic, oppositional and rhyming association as representative functions of word retrieval. The procedure makes use of assessment techniques which do not rely upon visual confrontation naming, yet are highly sensitive to verbal association impairments. The assessment phase consists of four single-word response probes comprised of a Free Word Association Probe, Semantic Association Probe, Oppositional Association Probe, and Rhyming Association Probe.

Verbal association has been documented as an area of deficiency in closed head injured patients (Levin et al., 1976). Therefore, it appears that evaluation of these skills would allow the examiner to define more clearly linguistic impairments in this population and to analyze their strategies used in verbal association. The purposes of this paper are: 1) to discuss the use of SORRT for the assessment of word association skills in closed head injured patients and to describe a 15-point multidimensional rating scale developed to analyze and quantify associative responses, 2) to compare the performance scores of closed head injured patients to those of the normal controls on the SORRT probes, 3) to compare and discuss pre-treatment and post-treatment probe results in the experimental group, and 4) to discuss treatment implications.

METHODS

Subjects. Twelve right-handed young adults, eleven male and one female, who had sustained a severe closed head injury served as subjects for the experimental group. Subjects ranged in age from 16 to 38 with a mean age of 23.82. They were no more than 3 months post onset at the time of initial testing with the average length of time post onset 48.50 days. Length of coma ranged from 2 to 40 days with a mean of 16.83 days. At the time of testing cognitive levels were identified according to the Levels of Cognitive Functioning developed at Rancho Los Amigos Hospital. The average level at test time was Level V. Results of computerized axial tomography for this group indicated no focal mass effect. The sample size was small in order to increase group homogeneity, particularly with regard to neurological impairment. The control group consisted of education-matched right-handed adults with no history of neurological disease or speech or language disorder. Subjects were also matched for age, sex and race.

Testing and treatment. The experimental group was administered the Boston Diagnostic Aphasia Examination (Goodglass and Kaplan, 1972) to rule out aphasia. Figure 1 is a composite Z-score profile for 15 of the subtests. Results do not depict a classical profile of aphasia but instead display a scattered pattern.

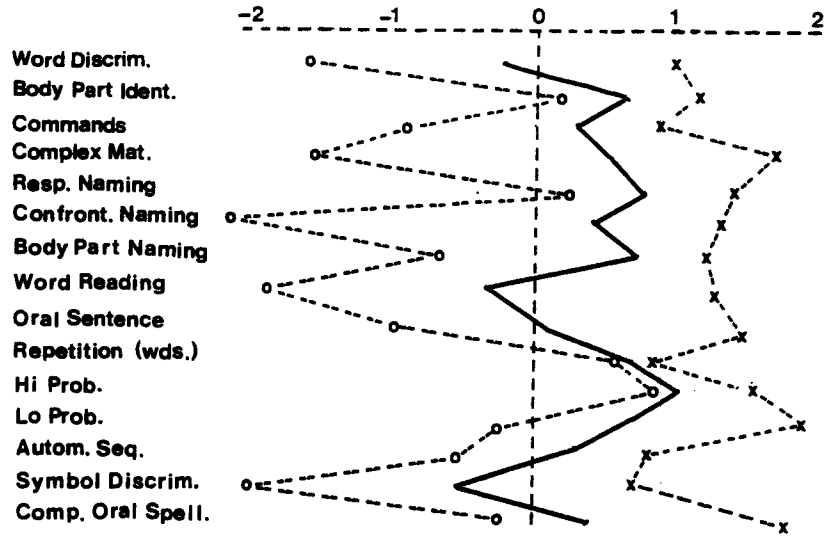

Figure 1. Composite Z-score profile, Boston Diagnostic Aphasia Examination. (-) = mean BDAE score. (O) = lowest score. (x) = highest score.

Both the experimental and control group were administered the SORRT probes to investigate word association skills. Normal subjects were administered the probes to provide the examiners with a basis for comparison of typical responses on the four word association probes: Free Word Association, Semantic Association, Oppositional Association and Rhyming Association

Nine of the closed head injured subjects who remained in our center long enough to receive intensive treatment were retested on all SORRT probes. The average length of time following initial testing was 70 days. Patients retested had progressed at least one cognitive level with the average level attained being level VI. Treatment strategies employed focused on structured tasks designed to improve basic cognitive processing rather than amelioration of specific word retrieval deficits. Treatment incorporated a hierarchy of associative thinking tasks which began with pictorial stimuli and gradually progressed to include lexical items.

Categorization of responses. A multidimensional rating scale, modeled structurally after the scoring system of the Revised Token Test (McNeil and Prescott, 1978) is presented in Table 1. The scale was developed to analyze and quantify the variety of responses elicited on the three word association probes which could not be accurately represented with the simple correct/incorrect dichotomy previously used with this instrument. Responses on the Free Word Association Probe were categorized as paradigmatic, syntagmatic or undifferentiated. Undifferentiated responses were those which could be classified as egocentric, elaborative, denied ability, atypical, perseverative (of a previous response), repetitive (of the stimulus word) or

bizarre-irrelevant. Examples of patients' responses on the Free Word Association Probe and the Semantic Association Probe are presented in Appendix A and B respectively.

Table 1. Scoring system for the Semantic, Oppositional and Rhyming Association Probes.

CORRECT		INCORRECT	
15	Correct	8	Error
14	Delay	7	Denied Ability
13	Atypical	6	Egocentric
12	Rehearsal	5	Elaboration
11	Self-Correction	4	Repetition (stimulus word)
10	Reinstruction	3	Perseveration (previous response)
9	Cue	2	Bizarre - Irrelevant
		1	No Response

RESULTS

The responses of the normal subjects on the Free Word Association Probe could be categorized as predominantly paradigmatic with no undifferentiated responses occurring. The means for the head injured subjects reflect a balance between paradigmatic and syntagmatic responses with 13.75% or responses being undifferentiated (Table 2). A sign test was used to compare differences in correct (a score of 15 through 9) and incorrect (a score of 8 through 1) responses of the normal subjects and head injured subjects. As would be expected, a comparison of the total number of responses for the two groups on the Semantic Association Probe indicates a significant difference in the type of word association elicited (Table 3). Similar differences were reflected on the Oppositional Association Probe and the Rhyming Association Probe (Table 3).

Table 4 contains the response classification of each of the head injured subjects on the Semantic Association Probe. A total of 240 under the score of "15" would indicate that all subjects scored perfectly. If we had considered responses strictly from a correct/incorrect dichotomy the majority of subjects would have exhibited only minimal impairment. By viewing the correct responses on a hierarchy based on the ability immediately to express an association or on the need for verbal assistance we can observe that of the 171 responses scored correct, 78 were categorized as nonimmediate. Nonimmediate responses would indicate that the patient required some type of facilitation such as delay or vocal rehearsal. The dispersion of response patterns was similar for oppositional association (Table 5) and rhyming association (Table 6), with the exception that performance on the Oppositional Association Probe was significantly better (Table 7) than performance on the other two probes. Using a sign test, it was found that subjects performed significantly better on oppositional association than on semantic association ($p < .05$) and rhyming association ($p < .0005$). There was no significant difference between performance on semantic association and rhyming association.

Table 2. Percentage and classification of responses on the Free Word Association Probe for closed head injured adults compared to normal adults.

	Closed head injured			Normal		
Subject	Paradigmatic	Syntagmatic	Undifferentiated	Paradigmatic	Syntagmatic	Undifferentiated
1	40	40	20	80	20	-
2	80	20	-	80	20	-
3	85	-	15	65	35	-
4	10	50	40	85	15	-
5	5	80	15	85	15	-
6	60	40	-	85	15	-
7	50	50	-	90	10	-
8	25	55	20	80	20	-
9	20	75	5	55	45	-
10	55	45	-	90	10	-
11	70	5	25	40	60	-
12	10	65	25	40	60	-
Mean	42.50	43.75	13.75	76.67	23.33	-

Table 3. Total number of responses per category on the Semantic Association, Oppositional Association, and Rhyming Association Probes for closed head injured adults compared to normal adults.

		Correct						Incorrect							
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
SEMANTIC															
CHI	93	17	9	18	7	19	8	34	6	2	6	6	6	8	1
Normals	200	11	15	7	4	-	-	3	-	-	-	-	-	-	-
(P = .0025)															
OPPOSITIONAL															
CHI	175	4	5	13	4	8	9	9	1	2	2	-	7	1	-
Normals	240	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(P = .0005)															
RHYMING															
CHI	110	14	1	29	8	17	11	29	8	-	2	5	-	4	2
Normals	214	12	-	4	3	4	1	3	-	-	-	-	-	-	-
(P = .0025)															

Table 4. Response classification on semantic associations for closed head injured subjects.

Subject	Correct								Incorrect								
	15	14	13	12	11	10	9	Total	8	7	6	5	4	3	2	1	Total
1	6	-	1	-	-	-	-	7	5	-	-	3	2	2	1	-	13
2	12	2	1	-	-	2	1	18	2	-	-	-	-	-	-	-	2
3	10	3	2	-	-	-	-	15	3	-	-	-	1	-	-	1	5
4	3	-	-	-	-	2	2	7	3	2	-	2	3	1	2	-	13
5	7	3	-	5	-	1	-	16	2	1	-	-	-	-	1	-	4
6	12	1	-	-	4	2	-	19	1	-	-	-	-	-	-	-	1
7	10	5	-	1	-	2	1	19	1	-	-	-	-	-	-	-	1
8	2	-	2	4	-	2	-	10	3	-	-	-	-	3	4	-	10
9	7	-	-	4	1	5	-	17	1	-	2	-	-	-	-	-	3
10	10	2	1	-	-	2	4	19	1	-	-	-	-	-	-	-	1
11	9	-	-	4	2	-	-	15	4	1	-	-	-	-	-	-	5
12	5	1	2	-	-	1	-	9	8	2	-	1	-	-	-	-	11
Total	93	17	9	18	7	19	8	171	34	6	2	6	6	6	8	1	69

Table 5. Response classification on oppositional associations for closed head injured subjects.

Subject	Correct							Total	Incorrect								Total
	15	14	13	12	11	10	9		8	7	6	5	4	3	2	1	
1	10	-	-	2	-	-	-	12	3	-	2	-	-	2	1	-	8
2	19	-	-	-	1	-	-	20	-	-	-	-	-	-	-	-	-
3	18	-	-	-	-	1	-	19	-	1	-	-	-	-	-	-	1
4	7	-	-	6	-	-	2	15	1	-	-	2	-	2	-	-	5
5	19	-	-	1	-	-	-	20	-	-	-	-	-	-	-	-	-
6	16	-	-	-	2	2	-	20	-	-	-	-	-	-	-	-	-
7	15	1	-	-	-	-	4	20	-	-	-	-	-	-	-	-	-
8	14	-	-	-	-	1	1	16	1	-	-	-	-	3	-	-	4
9	17	1	-	-	1	1	-	20	-	-	-	-	-	-	-	-	-
10	18	-	-	-	-	-	2	20	-	-	-	-	-	-	-	-	-
11	15	-	-	3	-	2	-	20	-	-	-	-	-	-	-	-	-
12	7	2	5	1	-	1	-	16	4	-	-	-	-	-	-	-	4
Total	175	4	5	13	4	8	9	218	9	1	2	2	-	7	1	-	22

Table 6. Response classification on rhyming associations for closed head injured subjects.

Subject	Correct							Total	Incorrect								Total
	15	14	13	12	11	10	9		8	7	6	5	4	3	2	1	
1	12	-	-	-	-	1	1	14	2	1	-	1	1	-	1	-	6
2	12	2	-	-	-	2	-	16	2	1	-	-	-	-	-	1	4
3	10	1	-	-	-	3	1	15	-	3	-	-	-	-	1	1	5
4	7	-	1	3	-	2	6	19	-	1	-	-	-	-	-	-	1
5	7	3	-	4	4	-	-	18	1	1	-	-	-	-	-	-	2
6	16	3	-	-	-	-	-	19	1	-	-	-	-	-	-	-	1
7	3	3	-	7	-	4	1	18	1	-	-	-	1	-	-	-	2
8	16	-	-	2	-	2	-	20	-	-	-	-	-	-	-	-	-
9	10	1	-	2	2	1	1	17	3	-	-	-	-	-	-	-	3
10	12	1	-	-	1	1	-	15	5	-	-	-	-	-	-	-	5
11	4	-	-	9	1	-	-	14	6	-	-	-	-	-	-	-	6
12	1	-	-	2	-	1	1	5	8	1	-	1	3	-	2	-	15
Total	110	14	1	29	8	17	11	190	29	8	-	2	5	-	4	2	50

Table 7. Comparison of closed head injured subjects' performance on the three word association probes.

Subjects	Number of Correct Responses		
	Semantic Association	Oppositional Association	Rhyming Association
1	7	12	14
2	18	20	16
3	15	19	15
4	7	15	19
5	16	20	18
6	19	20	19
7	19	20	18
8	10	16	20
9	17	20	20
10	19	20	17
11	15	20	14
12	9	16	5

Figure 2 is a comparison of the mean number of correct responses for the three word association probes for the nine subjects retested. All but one subject improved or maintained his previous level of performance on the Semantic Association Probe (2 subjects maintained, 7 improved), Oppositional Association Probe (5 maintained, 4 improved) and Rhyming Association Probe (1 maintained while all others improved). Although the purpose of this study was not to examine the effects of treatment on word association skills or on cognitive progress, noticeable improvement indicates positive effects.

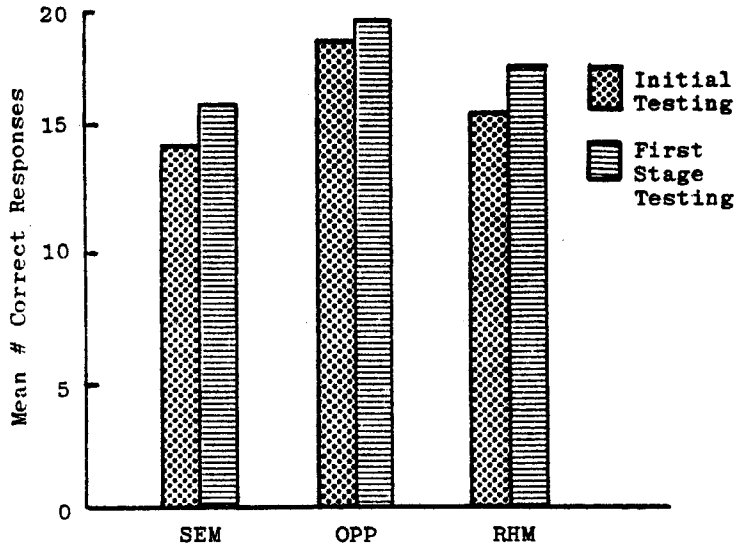

Figure 2. Comparison of mean number of correct responses on the three word association probes for nine CHI subjects for initial testing and Stage 1 post-treatment testing.

CONCLUSIONS

In conclusion, we found SORRT to be a useful instrument for the assessment of verbal association skills in closed head injured patients. It was sensitive to the detection of subtle linguistic impairment and did not merely delineate word finding problems. The test instrument was easily modified with the addition of a 15-point rating scale developed to provide the examiner with a quantifiable method for analyzing responses as well as providing terminology which allows for more accurate description of response behaviors. The scale provided a means for documentation of facilitative tactics such as delay and subvocal rehearsal and of examiner assistance such as reinstruction and cuing.

A comparative analysis of word association skills in closed head injured patients and normal subjects revealed that numerous responses by the closed head injured group were atypical and were indicative of linguistic impairment reflecting underlying cognitive disorganization. Comparison of responses on the three word association probes indicated subjects performed significantly better on oppositional associations than on semantic or rhyming associations. These results provided us with some important information for treatment. Employing the knowledge that oppositional associations are easier, we might then assume that patients will experience

more success at this task. For the patients in this study, oppositional associations appeared to be a good starting point for improving associative thinking at a lexical level.

Speech and language intervention directed towards reorganization of cognitive processes was seemingly beneficial in the recovery of closed head injured patients, although statistical measures were not employed. Speech and language pathologists, especially the clinical aphasiologist, have been well trained in the ability to evaluate, characterize and treat linguistic impairment secondary to neurological impairment. As such, it would appear that we have a significant role in the recovery of linguistic and cognitive functioning in the closed head injured population.

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APPENDIX A
RESPONSES ON FREE WORD ASSOCIATION

STIMULUS	RESPONSE	ANALYSIS
SALT	"PEPPER"	PARADIGMATIC
SALT	"WATER"	SYNTAGMATIC
SALT	"INTERROGATION"	UNDIFFERENTIATED: BIZARRE-IRRELEVANT
SALT	"SALTY"	UNDIFFERENTIATED: REPETITION STIMULUS WORD
MOUNTAIN	"HILL"	PARADIGMATIC
MOUNTAIN	"CLIMBING"	SYNTAGMATIC
MOUNTAIN	"HANG GLIDING"	UNDIFFERENTIATED: EGOCENTRIC
RUN	"WALK"	PARADIGMATIC
RUN	"AWAY"	SYNTAGMATIC
RUN	"RUNNING MEANS GETTING IT IN GEAR"	UNDIFFERENTIATED: ELABORATION
THANK	"WELCOME"	PARADIGMATIC
THANK	"YOU"	SYNTAGMATIC
THANK	"SHAKE HANDS"	UNDIFFERENTIATED: ATYPICAL

APPENDIX B
RESPONSES ON SEMANTIC ASSOCIATION

STIMULUS	RESPONSE		ANALYSIS
BIG	"HUGE"	15	CORRECT
LOOK	"TO ATTEND"	13	ATYPICAL
ANGRY	"ANGRY...ANGRY...MAD"	12	REHEARSAL
MOM	"DAD;NO, MOTHER"	11	SELF-CORRECTION
BAD	"MAN"; CL: "CAN YOU TELL ME A WORD THAT MEANS THE SAME AS BAD?" (RI) "MEAN"	10	REINSTRUCTION
BAD	CL: (FOLLOWING RI) "IF YOU'RE BAD, YOU'RE ____" "MEAN" (C)	9	CUE
BOAT	"AVERAGE FISHERMAN; (RI) FISHERMAN"	8	ERROR
ALL	"ALL; (RI) I DON'T KNOW; (C) I DON'T KNOW ONE"	7	DENIED ABILITY
AFRAID	"ROOM"; (RI) "I'M SCARED TO DEATH OF MY ROOM"	6	EGOCENTRIC
ALL	"SEE; PAUL; (RI) ALL THE PEOPLE, PEOPLE ARE ALL"	5	ELABORATION
LOOK	"LOOKING; (RI) LOOK AND SEE"	4	REPETITION STIMULUS WORD
SAD	"BYE (PREVIOUS RESPONSE HAD BEEN GOOD-BYE); (RI) GOOD-BYE"	3	PERSEVERATION
PURSE	"I DON'T KNOW, SOMETHING; (RI) SUBSTANCE"	2	BIZARRE-IRRELEVA
		1	NO RESPONSE

RI = REINSTRUCTION
C = CUE
CL = CLINICIAN

Q: What were the measures used to assess the effects of treatment?
A: Retesting with the SORRT probes.

Q: You retested and you saw changes?
A: Yes.

Q: Do you have any ideas of what the behavioral responses were for the specific tasks that you used? Specifically in terms of how long it took them to reach particular criterion on each of the levels of training? Could you talk about that for a little bit?
A: We weren't looking at linguistic progression as much as we were looking at cognitive progression. This was identified according to the levels of cognitive functioning which have been used at Rancho Los Amigos. There are descriptive guidelines for looking at things like selective attention, increased memory for daily activities, ability to follow commands and for assessing progression. That's when we reinstated testing. We tested initially when they were seen and identified the cognitive level. Then they progressed cognitively and they would be retested using the SORRT probes.

Q: Did you see changes on the behaviors used in treatment? You didn't show any treatment data. Did they improve in their ability to do those tasks?
A: Yes. We would start on one task and continue until they would achieve 100% accuracy and then progress to something more difficult.

Q: Do you have any idea what would have happened if you had not trained and just waited a period of time and reassessed using the SORRT testing?
A: I imagine that there would still be improvement, although perhaps not as rapid.

Q: Did you vary your tasks at all based on individuals' inabilities to give associations to increase their paradigmatic associations? Did you focus on that and then train for specific word associations?
A: No. We focused more on associative thinking and making associations. We started out with simple tasks. The progression includes a lot more tasks than were shown. Working on specific paradigmatic responses was not our aim.

Q: Suppose the patient gave all one type of word association and never associations in another category. Would you modify that by giving cues to encourage that type of response?
A: No.

Q: Do you have any ideas of the kind of range that it took to teach certain behaviors? What were the amounts of time?
A: Head injury patients progress fairly rapidly. The average length of time between our initial testing and second stage testing was 70 days, but that's because we had some severe head injured patients in our group who progressed much slower than those less severely involved.

Usually progression from one cognitive level to another with this population is 4 weeks on the average.

Q: Where is SORRT described?
A: It was presented by Duane Logue and Martha Dixon in 1979.

Q: Where?
A: It is in the Conference Proceedings of the CAC 1979.