■特別講演

The Management of Neuropsychological Problems in Right Brain Damaged Stroke Patients

Leonard Diller, Ph. D*

While neuropsychological problems associated with right hemisphere damage and left hemiplegia have been well documented since the turn of the century (Dimond and Beaumont, 1974), the major insights have been from a neurological and/or neuropsychological perspective. Such a perspective attempts to correlate the presence of brain damage with patterns of disturbance in behavior and cognitive functions. This type of correlation yields more refined observation of patients following brain damage and to the use of neuropsychological tests to identify the presence of brain damage (Lezak, 1983). Since this approach was developed in neuro-surgical or neurological settings, the methodology has been used most often in adding to diagnostic tools in the armamentarium of the neurologist.

However, in rehabilitation the perspective is somewhat different. For most patients referred to rehabilitation settings due to a stroke are referred not because of the question of brain damage. The referral is to analyze and ameliorate the disabilities which follow stroke. The assessment of disabilities and impairments takes on a different meaning. Hemiparesis may represent only one dimension of impairment in a complex multidimensional syndrome. Rehabilitation is more actively concerned with treating impairments, and helping people to overcome disabilities and manage their lives as productively as possible. In addition to knowledge

about the presence of brain damage, information derived from a knowledge of impairments must also be translated into a knowledge about disabilities. For example, a neuropsychological profile may indicate the presence of visual perceptual problems following right brain damage. Translating these problems into methods for dealing with functional disorders in activities of daily living is a major need provoked by rehabilitation. Indeed, a dialogue between a neuropsychologist coming from a neurological tradition and a rehabilitation therapist maybe paraphrased as follows.

The neuropsychologist might argue that neuropsychological assessment is necessary because in approaching activities of daily living (ADL) how does one know what to treat without a knowledge of underlying impairments. A rehabilitation worker might argue what is the purpose of an assessment of impairment if it cannot be translated into a language of functional disabilities. In brief, the application of neuropsychological methods to problems in rehabilitation can sharpen the focus and meaning of diagnosis and suggest ways of enhancing therapeutics. It can help extend the knowledge base of both neuropsychology and of rehabilitation.

This paper will be divided into three sections. The first part will describe an example of how a psychological study can be used to illuminate an important issue in rehabilitation. The second part will describe a series of studies in which neuropsychological tools were used to develop treatment programs for problems of visual neglect and the third part will illustrate how neuropsychological tools can be used to uncover impairments which came to notice after target specific treatments were successfully applied.

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1988年6月3日, 第25回日本リハビリテーション医学
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I. Impairment and Disability : The Principle of Common Pathways

In neuropsychology both animal and human studies suggest that individuals with different areas of brain damage may fail or pass a common task. However, The failure may be associated with different deficits related to different areas of brain damage. Two studies conducted in Rehabilitation Medicine settings illustrate this. The studies are cited because their methodologies also might be of interest to rehabilitation workers.

Before presenting the first study, it would be useful to present the following experiment. A group of hemiplegics while seated in a dark room, was asked to adjust a luminous line so that it appeared to be in a straight vertical position. While normal individuals and individuals with left brain damage and noticeable aphasia were able to indicate the true vertical plane, right brain damaged patients with left hemiparesis tended to tilt the line counterclockwise, indicating that it was in a 6 o'clock position when it was actually 10 minutes to the hour. (Birch, Belmont, Reilly and Belmont, 1961 ; Diller & Weinberg, 1962). The patient with right brain damage also tilts the luminous line in a counterclockwise direction when presented in the horizontal plane. Instead of setting the horizontal plane at 15 minutes to the hour, the patient will set the horizontal at 25 minutes to the hour, so that both horizontal and vertical space are tilted in a counterclockwise direction. An interesting series of corollaries of this finding is that (a) right brain damaged persons tend to tilt copying tasks in both drawings and handwriting in a counterclockwise direction (Diller and Weinberg, 1968). (b) Left hemiparetics with right brain damage tend to displace their center of gravity to the right side of the body so that when touched on the back the person with right brain damage will indicate that the backbone is displaced to the right of its actual location (Diller, 1974). The individual will also err in bisecting a line by displacing the midpoint to the right. (c) The misperception of the vertical plane is correlated with falling in both normal elderly individuals living in the community (Tobis, Novak, and Hoehler,

1981) and in hemiplegics (Birch, et al, 1961).

While right brain damage patients perform poorly in the perception of space, left brain damaged patients do well. By way of contrast right brain damaged patients perform adequately in tests of language, while left brain damaged patients perform poorly. When confronted with a novel learning task where the individual is required to guess the correct response, when the correct response is being altered systematically, right and left brain damaged people perform at equal levels. However, for the right brain damaged person success is related to the degree of impairment in responding to the perception of the horizontal and vertical planes while for the left brain damaged person success is related to the ability to follow verbal directions of increasing complexity. Thus, two individuals with stroke might receive the same score on a test, but the reasons for the performance may differ depending on the side of brain damage and the specific abilities which are impaired.

The principle can be illustrated in a second study and brought even closer to rehabilitation situations. In learning to transfer to and from a wheelchair, hemiplegics received daily practice in a room with different kind of chairs. Proficiency in transfer is generally evaluated in terms of level of assistance needed. While observing hemiplegics receive instruction in transfer activities, it was noted that a hemiplegic typically practices transfers on a daily basis with 6 different trials. This activity is regarded as essential by the staff as well as by patients who wish to be more independent in transfer activities. This situation is in contrast to classical studies of laboratory learning in brain damaged subjects where artificial incentives maybe contrived by an investigator to insure cooperation by the subject (Blackburn, 1958). While right and left brain damaged patients achieve the same results in terms of levels of assistance, they differed when the transfer task is analyzed into a series of steps which are required to complete the task successfully, e.g., lifting the foot pedal, locking the brake on the wheelchair, placing a cane in the proper position, moving the body into appropriate positions, etc. (Diller, Buxbaum & Chiotelis, 1972). It was noted

that right and left brain damaged performed about equally well in terms of progress in level of assistance, but they showed different patterns of errors in performing transfers. For right brain damaged hemiplegics, error patterns were related problems in visual perception. For left brain damaged hemiplegics, error patterns were related to problems in processing auditory verbal information. Thus, two people requiring the same level of assistance in learning to transfer make different patterns of errors which are related to different cognitive impairments. This raises the notion that people with different patterns of cognitive impairments due to brain damage might learn the same ADL task differently and might be taught in different styles. It further suggests that a neuropsychology of skilled performance maybe related to a neuropsychology of learning and to a neuropsychology of teaching.

II. Problems of Neglect and Their Management

Studies of cognitive processing in stroke patients suggested that right brain damaged, left hemiplegics tend to show primary impairments in visual perception which could be characterized as a visual inattention to stimuli presented in space opposite to the side of brain damage. Left brain damaged, right hemiplegics presented primary problems in the processing of serial information particularly when presented via the auditory modality (Diller & Weinberg, 1968). Such difficulties would appear to be an underlying parameter of cognitive impairment in aphasia. While problems of aphasics have received extensive study and have led to therapeutic approaches in speech therapy, visual perceptual problems have not been explored as systematically so that taxonomies of visual perception and therapeutic approaches to these problems have not been as developed or as widely accepted (Diller & Weinberg, 1977).

While visual perceptual disorders have been approached from the standpoint of disturbances in sensory deficits (Gianutsos & Matheson, 1987) from a rehabilitation standpoint it was deemed more useful to view the problems in terms of disturbances in hemi-attention for the following reasons. Clinical

observation suggested that while learning activities of daily living, left hemiplegics appeared to be paying attention largely to stimuli which were presented in the right half of the visual field while ignoring those on the left and it was fairly easy to document individual's looking patterns and calibrate them on tests for which scores could be generated.

My colleagues and I developed a simple paper and pencil test, a visual cancellation task (Weinberg, Diller, et al, 1977). The task had the following properties which were useful: (1) It presented an equal number of targets in different parts of visual space (right, center, left), (2) stimuli could be varied to make the task harder or easier by changing the information load, i. e., number of targets to be cancelled, distance between stimuli in that targets which are close to each other tend to be more difficult, and size, i. e., small stimuli are harder than large stimuli. (3) The patients approach to the task could be easily documented and the errors could be scored. We applied the cancellation test to over 100 left hemiplegics and we found a wide range of approaches to the task. When we tabulated the number of errors, we found all of the errors were those of omission rather than commission. They tend to occur more often in the left side of space than the right side of space. They increase if patients are asked to cancel more difficult types of stimuli.

In one series of studies it was observed that right brain damaged persons could be divided into mild, moderate, and severe in terms of the number of errors in visual cancellation. The severe groups which tended to have a high incidence of visual field defect, showed signs of gross neglect. The behavioral manifestations of neglect were seen in grooming (men appeared poorly shaved and women appeared with poor application of makeup), difficulty in reading newspapers (Weinberg & Diller, 1968), omitting food on the left side of a tray, increased number of accidents (Diller & Weinberg, 1970). The mechanisms behind neglect are unclear, e. g., there appear to be differences in eye movements between severe neglect, mild neglect and normal individuals in terms of fixations and latency in saccadic movements (Johnston, 1984). Individuals without gross

neglect may have a bias in responding to stimuli on the contra lateral side of brain damage because of a problem in relaxing attention to stimuli on the right side (Egelko, et al, in press). Individuals with mild or covert neglect whose performance is not greatly disturbed on visual cancellation tasks can be shown to have attentional biases.

Individuals with neglect who received conventional treatment in rehabilitation medicine settings with no systematic treatment program, tend to improve at discharge (Gordon, et al, 1985), and at 4-month-follow-up, but their performance is still markedly impaired.

The visual cancellation task can also be administered under varying conditions so that under different instructions patients can improve their performances. For example, when individuals are told to begin their cancellation from a right to left direction, or when individuals are told to slow down, their cancellation errors are reduced. The systematic exploration of changes resulting from varying instructions provided a method of specifying the conditions which could be used to treat phenomena of neglect (Diller, 1974).

One important aspect of neglect is denial. Denial makes it difficult to engage the patient in a treatment program. The denial is fostered by the fact that neglect is not experienced directly, but can only be inferred by the patient from the fact that traditional looking habits may cause an occasional mishap or that traditional visual tasks such as reading require a great deal of effort. From a patient's perspective there may be a feeling that something is amiss and that perhaps there may be a loss of mental faculties. Because the patient is afraid that sanity may be deserting him, he may cover up the problem and to conceal this from himself and others, the patient minimizes or denies the problem. Unlike aphasia wherein a language problem is a public event known to others as well as the patient, a visual perceptual problem is a private event. It is not experienced or observed directly by an outsider.

Based on the observations of responses when conditions were altered, a remediation program to overcome problems of neglect was developed. The

key feature of neglect is a difficulty in scanning. This difficulty can be further analyzed into the following activities which are translated into principles which can be used for treatment. (1) **Anchoring**, providing an indicator for the starting point of the scan. For example, a red line may be drawn on the left margin of the page to indicate where the print begins, (2) **pacing**, directing the gaze in a left to right fashion in a steady way, to curb impulsiveness. For example, the patient may recite the material being read aloud, (3) **Feedback**, providing external reinforcement for correct responses, to let the patient know when the response is correct, (4) **Practice**, continued practice in necessary to make a voluntary act habitual. Because voluntary acts require more effort, it is important to change looking behavior into looking habits. (5) **Density**, to make recognition easier, stimuli may be enlarged or widely spaced. Errors are increased when target stimuli are close to each other. (6) **Reduced information** load, to decrease the effort required to perform the task. For example, single stimuli rather than two or three stimuli may be chosen as targets.

Materials and exercises were developed to translate these principles into training activities. In addition, to help overcome the problem of denial, a scanning machine was developed. This consisted of a simple board approximately 78 in. wide and 18 in. high. Around the perimeter of the board was a red disc which would be moved back and forth by the trainer. The patient seated in front of the board is required to track the disc. Patients with neglect tend to lose the disc when it appears in the left half of space. In order to follow the disc the patient may be required to turn his/her head to view the target from the intact visual field. The board has a series of different colored lights which may be turned on individually or in serial fashion. The patient is asked to indicate which lights have been turned on. Practice with this device takes place daily in half-hour sessions which may run 4 to 8 weeks.

In addition to the scanning machine, a version of the visual cancellation task is used for daily exercises wherein the principles of anchoring, pacing, feedback, rehearsal, density and stimulus load are used within the same half-hour daily session.

Fig. 1 Cancellation of simple target (H), circles indicate target was omitted. Pre-training (8/28/72), Post-training (11/1/72).

Fig. 2 Copying handwriting — pre- and post-training.

Note in pre-training (above line) : (1) Starting point, (2) Tilt of lines in counterclockwise direction, and (3) Omissions.

The scanning machine and the cancellation exercises form the basic core for training.

In a study which compared a group of right brain damaged stroke patients who received this program with a group of right brain damaged patients who

received conventional inpatient rehabilitation, it was found that the treated group showed significant improvement on visual cancellation tasks and a variety of visually related tasks including academic performance (reading, writing, and paper and pencil

arithmetic) and pictorial tasks (counting faces, matching faces, picture completion) (Weinberg, et al, 1977).

However, improvement was not found on two types of tasks. The first consisted of body/spatial awareness such as location of the body midline and line bisection and the second consisted of tasks which did not reflect overt neglect, but reflect inadequate distribution of attention. For example, while concentrating on the mechanisms of reading words accurately the patient may overlook the meaning of what he/she is reading. Reading comprehension scores would, therefore, lag behind reading achievement scores which measure only the mechanics of reading or lag behind a person's ability to read a passage aloud.

Two studies were designed to address these problems. In the first study (Weinberg, et al, 1979), scanning training was supplemented by a program designed to treat disturbances in spatial organization and sensory awareness above and beyond scanning. Thirty right brain damaged patients received training in sensory awareness by learning to touch the back of a manikin to match the same spot on the back wherein the patient was touched. (The patient was reinforced for the correct response by having a light appear over the spot which was touched.) The patients also learned to match distances on a board resting on a desk in front of them. The subjects who received training performed better in ability to recognize the backbone when touched and in the ability to bisect lines when compared with 23 right brain damaged patients receiving conventional rehabilitation. This indicates that when sensory awareness training is added to scanning training there will be improvement in body awareness and spatial extent.

In the second study, 17 right brain damaged patients were taught to compensate for a persistent asymmetric lateral bias by learning to recall the location in space of visually presented words or dots. The procedure involved breaking down the page into systems of spatial coordinates, e. g., quadrants and placing the stimulus within the appropriate quadrant. Patients receiving the training showed greater improvement in a cluster of tests reflecting

visual organization, analyses and syntheses, when compared a control group of right brain damaged people receiving conventional rehabilitation. In short, many of the features of figure ground problems in classical psychology could be addressed by altering looking habits (Weinberg, et al, 1982).

An attempt to follow these studies with a comprehensive program which combined all of the previous treatments and test for the carryover revealed that the experimental group of 48 right brain damaged patients showed greater gains than 29 right brain damaged control patients on all of the domains measured in the three previous studies at discharge. However, when retested at 4 months after discharge from rehabilitation the control group tended to catch up to the treated patients. While different explanations have been offered to account for the fact that the experimental and control groups approach each other in performance at four months, at a minimum the retraining program has speeded the process of recovery (Gordon, et al, 1985).

III. Perceptual problems and related Disorders in Right Brain Damaged People.

In the course of our remediation work with left hemiparetics due to right brain damage, three areas of related deficit emerged. Problems in arousal, affect and thinking. These deficits which have been reported by different investigators using animals and humans, suggest that the perceptual deficit in right brain damage is often accompanied by other impairments which might interfere with rehabilitation. The identification of these deficits, methods of measuring their presence, analyzing their critical features, their functional consequences and their remediation appears to pose a major next step in facilitating patient management.

Arousal

While problems of awareness of disability have been classically associated with right brain damage since the turn of the century (Weinstein & Kahn, 1955), recent experimental (Heilman, KM, et al, 1977) and theoretical work has directed observations to phenomena of arousal. In a rehabilitation setting we have observed such phenomena not only in test situations but also in gross clinical activity

where patients fall asleep during remediation sessions, respond slowly in conversation or activities. While studies of the way patients spend their time during rehabilitation reveal that more time is spent in passive behavior—42%—(sitting, napping, watching television) than in actual treatment—31%—(Keith, 1987), it is difficult to document that such a high percent of time spent in passive behavior is particular to stroke patients since spinal cord patients show a similar effect (Willems, 1976).

In our setting we have found that in using measures such as reaction time, speed of tapping, cancellation rate, inhibition of motor response and a clinical rating by an examining neurologist-arousal problems occurred more often in right brain damaged than in left brain damaged patients (76% vs. 28%) and more often in association with visual field deficit (VRD=85% vs. non-VFD=38%) in a study involving 221 stroke patients (Diller, 1988). Since there is such a high incidence of arousal problems, the question arises as to whether it is possible to treat problems in arousal just as one treats problems in visual perception. While one can train patients with right brain damage to improve on tasks which measure arousal, there are as yet no statistical data to indicate carryover to practical activities in daily living. Clinical and anecdotal experience suggest, however, that some patients who have difficulty with visual perceptual retraining can benefit from additional training in arousal.

Affect

The emotional problems of people with right brain damage have traditionally been viewed as relatively minor intrusions in the overall adjustment. Indeed, the classical view that right brain damage is associated with indifference and denial, while left brain damage is associated with depression and anxiety is supported by the observations of Sackheim et al, 1982, who found pathologic laughing associated with right brain damage and pathologic crying associated with left brain damage. Asymmetry of emotional responses dependent on side of brain damage is also supported by the work of Robinson, with animals (Robinson & Coyle, 1980)

as well as humans (Robinson, RG & Price, TR, 1982). Yet clinical experience suggests that many right brain damaged stroke patients are depressed. Ross (1981) and Ross and Rush (1981) have argued that people with right brain damage may have a disturbance in processing affect both in understanding affect and expressing affect. Ross has used the term *aprosodia* to characterize the inability to process affect. Furthermore, he argues that *aprosodia* in right brain damage, is analogous to aphasia in left brain damage, in that damage to the anterior part of the brain is associated with expressive loss and damage to the posterior part of the brain is associated with receptive loss.

Ross' formulation suggests that one reason why right brain damaged patients have traditionally been characterized as indifferent or elated is that the content and the style of the affect are confounded. In affect a stroke patient whose voice and expressions are narrow in range will be less likely to attract clinical attention when he/she says, "I am sad," than a patient who can express sadness in style as well as content. In order to investigate the matter further, the following study was conducted in our program (Diller, 1988). One hundred and fifty right brain damaged patients were assessed on a variety of tests and on self ratings. It was found that 2/3 of the group were characterized as depressed on the Beck Depression Inventory, the Hamilton Rating Scale for Depression, and the MAACL (Multiple Affect Adjective Check List). However, it was also noted that 70 per cent had a disturbance in comprehending affect using both auditory and visual stimuli. While these observations tend to support Ross, other findings in the study do not, in that, similar results appear to hold true for individuals with damage to the left hemisphere ($n=71$). Incidentally, the control group ($n=22$) showed an incidence of pathologic performance of only 14 percent for both the depression and the affect comprehension measures. We also found that many of the measures of depression, e.g., Beck scale, involve somatic items such as poor sleep, appetite loss, slow responses. These items may not reflect depression in a stroke population. Rather they may reflect problems associated with being ill or in a hospital.

Furthermore, they are less reliable than the non-somatic items.

These findings suggest that affective disturbances in right brain damage are common and that two dimensions of affect must be considered—the content of the affect and how affective information is processed. As yet, there are no formal controlled studies on the management of these problems, but behavioral and psychopharmacologic approaches might be appropriate.

It also may be noted that in follow-up studies during the first year after stroke, depression and arousal do not improve over time while gross neglect does improve. Furthermore, depression and diminished arousal are associated with passive activities such as resting and looking at TV and a diminished involvement with active recreational pursuits and leaving the house (Gordon, et al, 1985). Because the relationship which has been established up to this point in time is only correlational, but not causal it is difficult to say whether depression leads to hypoarousal, whether hypoarousal leads to depression or whether they both co-exist.

In conclusion, in a series of studies it has been demonstrated that right brain damaged patients with problems of visual neglect or inattention can be taught to scan their environments to overcome some of the visual perceptual problems which are often associated with hypoarousal and depression. The depression maybe masked by an inability to understand affect. The psychological defects following right hemisphere damage are, therefore, capable of being specified. Such specification would offer promise for developing more precise strategies for a direct intervention and overall management.

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〈報 告〉

評価基準委員会

日 時：昭和63年11月16日

午後3：00～6：00

場 所：東京ステーションホテル

出席者：初山泰弘，鈴木堅二，蜂須賀研二，
畑野栄治，真柄 彰，三上真弘，
米本恭三（担当理事）

議 題：

1) 職業前評価小委員会報告（三上）

152施設中103施設（67.8%）からのアンケート結果資料に基づき，次の結論を得た。現時点では“職業前評価”の用語が曖昧に用いられているが，リハビリテーション医学の治療過程および結果から到達できる能力の中で，職業に関係する能力の評価を職業前評価と考える。

しかし，能力評価の順序はADL評価，生活関連動作評価，職業前評価ということになり，職業前評価を検討する前に生活関連動作の概念を規定することが先決である。次回は生活関連動作について案

を作成する。

2) ROM 小委員会報告（蜂須賀，畑野）

- ① 基本的にはASOの要項に忠実に行った。
- ② 現行の中で誤植と思われるもの，不明な部分について訂正を試みた。
- ③ 原則として他動運動を測定する。
- ④ 二関節筋は弛緩した状態で測定する。資料を整理後リハ医学会長に提出，会長を介して日整会と連絡をとる。

3) ADL 小委員会（真柄）

小委員会を再度開催し結論を出す。

4) その他

- ① 懸案となっていた高次脳機能障害の中の一側視空間失認について福井先生に講師を依頼する。
- ② 学会内規に従って行う委員の交代案について委員長より提案された。

（文責：初山泰弘）