Recovery from Aphasia and Nonverbal Impairment in Stroke

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Spontaneous Recovery

We had the opportunity to study a mostly untreated aphasic population in the last ten years and recently published certain observations about recovery of language (Kertesz and McCabe, 1977; Lomas and Kertesz, 1978). That situation has changed with the establishment of a communicative disorders program at the University of Western Ontario. Now aphasia therapy is carried out in every acute and chronic hospital in London. Untreated patients are rarely followed in clinics. Table 1 compares the untreated or control groups of various recovery studies. The conclusions from our two recovery studies are summarized below:

1. Significantly more recovery occurs in the first 3 months post-onset.
2. Recovery rates progressively decrease from 3 - 6 months, and 6 - 12 months, and a plateau is usually reached in a year.
3. Post traumatic patients have a better prognosis.
4. Initial severity is the most important prognostic indicator for the overall population.
5. Broca's aphasic patients recover most, followed by conduction and some Wernicke's aphasic patients.
6. Age and sex are not significant factors.
7. 40% of aphasic stroke patients have excellent recovery when followed for a year; 13% good, 19% fair and 28% have poor outcome.
8. The evolution of aphasic syndromes follow a well defined pattern:
   Global aphasia often improves to become severe persistent Broca's aphasia.
   Broca's aphasia often improves to become anomia.
   Wernicke's aphasia often improves to become anomia.
   Conduction aphasia, transcortical aphasia, anomic aphasia often recover completely.
9. Comprehension recovers most, word fluency least.
10. A careful but practical assessment which measures spontaneous speech fluency, comprehension, repetition and naming and classifies aphasia into clinically common and distinct varieties is more useful to the clinician than a holistic, amorphous, undifferentiated view of aphasia.

Table 1. Spontaneous Recovery Studies.

	Year	Number
Vignolo	1964	27
Culton	1969	21
Sarno	1970	8
Sarno	1971	17
Hagen	1973	10
Kertesz	1977	83
Basso	1979	119

Recovery and Language Therapy

Since we have followed so many aphasic patients we have learned a great deal about the importance of reproduceable measurement of aphasic impairment. We have branched out into measuring other factors influencing recovery, including therapy. Until recently, and even now in the majority of instances, aphasia therapy has been variable in duration, intensity and methodology. Dr. Cynthia Shewan and I, with the collaboration of the Speech Pathologists in London, have undertaken a Recovery Study in which three forms of aphasia therapy and a control group are followed with the Western Aphasia Battery (Kertesz and Poole, 1974), and Dr. Shewan's Auditory Comprehension Test for Sentences (Shewan, 1976). The methodology is carefully worked out to avoid the pitfalls which make the results of other studies practically uninterpretable. First of all, the patients are screened neurologically to exclude multiple strokes, neoplasms, those who live too far to come for therapy, and start therapy not before two weeks and not after six weeks of onset. The patients are also randomized and matched according to initial severity and aphasia type since neglect of these variables invalidates comparisons. The first lesson from our labours is a painful one: the number of aphasic patients suitable for participation in a carefully randomized study is small.

Table 2 illustrates the number of patients actually included compared to the number surveyed for inclusion after a year. This is comparable to the dropout rate of Wertz, et al(1978). The reasons are multiple: the number of strokes appears to be declining; (A recent article in the New England Journal of medicine attributed the 32% drop in stroke rate to the treatment of hypertension.). The referred patients often turn out to have other cerebral lesions or drop out due to concurrent illness or lack of cooperation; logistical problems of maintaining therapy for six months are formidable. We seem to have fewer patients available for the study than we were initially counting on, suggesting that there is some truth in the facetious observation about clinical research: "the best way to cause a disease to disappear is to undertake a randomized clinical trial."

Table 2. Language Therapy and Recovery from Aphasia Project; C.M. Shewan and A. Kertesz. Statistics - May, 1978 - May, 1979.

REFERRALS TO STUDY:

128 Referrals

33 Accepted (28 Active Participants: 21 Treated and 7 Control)

100 Excluded

Recovery of Nonverbal Function in Aphasics

In addition to our studies of language recovery, we have accumulated data on the recovery of nonverbal function in aphasic patients, as measured by Ravens' Coloured Progressive Matrices, Block Design, and our drawing task. Very little information is available concerning the recovery of nonverbal function in the literature, in contrast to that on recovery and treatment of aphasia. Previous studies found performance on Ravens' Coloured Progressive Matrices (RCPM) impaired in a general aphasic population (Archibald et al., 1967; Kertesz and McCabe, 1975). Culton (1969) administered Raven's Standard Progressive Matrices to 11 aphasic patients and found considerable recovery of nonverbal performance in the group 2 months post onset, and no recovery in the group beyond 11 months. Campbell and Oxbury (1976), examined right hemisphere damaged patients 3 - 4 weeks and 6 months after stroke with verbal and nonverbal tasks including block design and matrices. Those with neglect on drawing on the initial test remained impaired on visuospatial tests 6 months later, in spite of the resolution of neglect. Other reports describe inattentionup to 12 years after onset.

Our own previously published analysis of RCPM performance and language function suggested that impaired comprehension is the most prominent subtest correlating with RCPM, and that aphasic subjects with initially poor comprehension (global, Wernicke's and transcortical sensory aphasias) show poorer performance on the RCPM (Kertesz and McCabe, 1975). The hypothesis occurred to us that recovery of language function, especially comprehension, should be paralleled by recovery of nonverbal performance, as measured by the RCPM, if these neuropsychological functions or their disturbances are related.

We undertook studying recovery of visuospatial nonverbal function with the RCPM and correlated it with various language functions in the aphasic stroke patients. They were right handed and had a single vascular episode in the left hemisphere, as proven by hemiplegia or isotope scan. This study included 63 aphasic patients who had both the RCPM and the Western Aphasia Battery, our standardized aphasia test, within 1-3 and 3-6 months after the onset of their stroke. Twenty patients with aphasia had 6-12 month reassessments as well. We divided the subjects into taxonomic groups according to our previously published criteria (Table 3) by their test scores. The RCPM recovery is contrasted with language recovery in Figure 1 for each aphasia type.

Table 3. Criteria for Classification.

	FLUENCY	COMPREHENSION	REPETITION	NAMING
Global	0-4	0-3.9	0-4.9	0-6
Broca's	0-4	4-10	0-7.9	0-8
Isolation	0-4	0-3.9	5-10	0-6
Transcortical Motor	0-4	4-10	8-10	0-8
Wernicke's	5-10	0-6.9	0-7.9	0-7
Transcortical Sensory	5-10	0-6.9	8-10	0-9
Conduction	5-10	7-10	0-6.9	0-9
Anomic	5-10	7-10	7-10	0-9

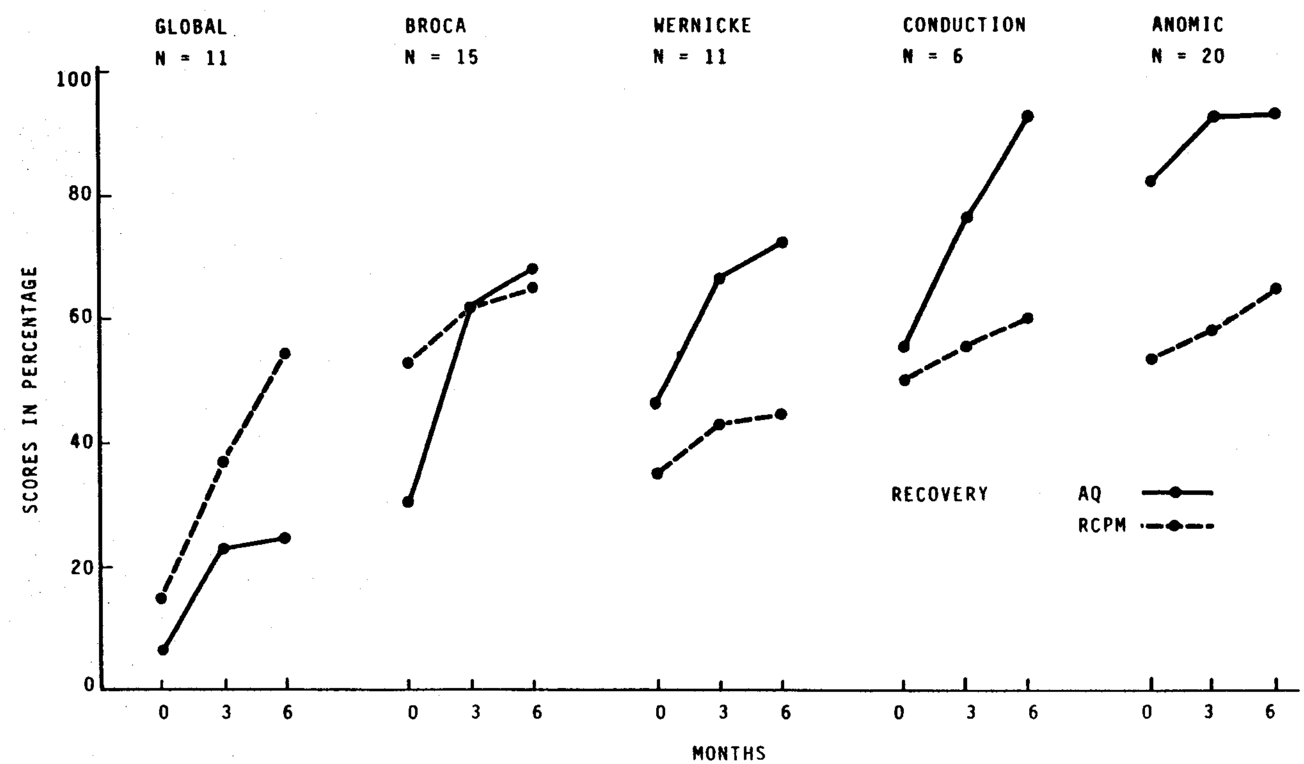

Figure 1. Recovery of five groups of aphasic subjects. RCPM=Progressive Matrices. AQ=Language Recovery.

1. Global aphasic subjects show the most recovery on Raven's Matrices compared with language. This is the only group in which visuospatial function recovers more than language function.
2. Broca's aphasic subjects show dramatic language recovery but only modest improvement in Raven's performance.
3. Wernicke's aphasic subjects have poor recovery of visuospatial performance compared to language. The scatter is considerable.
4. Conduction, transcortical, and anomic aphasic patients show little if any recovery of Raven's performance, but their high initial score is responsible for this more than anything else.

All aphasic individuals who were followed through all 3 intervals, 0-3, 3-6 and 6-12 months post onset, were considered together (N=20). This was a fairly representative sample of the aphasic population: 3 globals, 6 Broca's, 4 Wernicke's, 5 anomic and 2 conduction aphasic subjects. The recovery rates were lower for the RCPM for the first 3 months, but it continued to rise at nearly the same rate in the second interval, in contrast to language, which plateaued after 3 months (Figure 2). The recovery of visuospatial intelligence in aphasic subjects seemed to continue, even in the 6-12 month interval. Recovery rates for language and RCPM were significant ($p \leq .05$) in all intervals, as calculated by the repeated measures test (Table 4).

Table 4. Recovery Rates of Language and RCPM in Aphasics.

Interval in Months	N	Comprehension	AO	RCPM
0-3	20	17.6**	23.5**	8.6*
3-6	20	3.3**	3.6**	7.1**
6-12	20	2.5*	4.4**	6.3**

* $p \leq 0.05$
** $p \leq 0.01$

The correlation of RCPM recovery rates with the recovery of various language parameters measured by the WAB reveals that the correlations are the most significant in the 0-3 month period; this is the time for the highest recovery rates (Table 5). Reading, responsive speech, sentence comprehension, word recognition and object naming are correlated most significantly ($p \leq .01$) and sentence completion, repetition, AQ, drawing and praxis also correlate ($p \leq .05$). In the 3-6 month period, only reading, and in the 6-12 month period, responsive speech, correlated ($p < .05$).

In conclusion, although recovery of Raven's performance, measuring nonverbal intelligence, correlates in a general fashion with recovery of language function, more severely affected Global aphasic subjects seem to recover more from nonverbal impairment than language, and the reverse is true for other types of aphasia. Although Raven's matrices and similar nonverbal performance tests are often impaired in aphasia, recovery from language and nonverbal functions are not always parallel.

Table 5. Correlation of RCPM and WAB Subtests Recovery.

SUBTESTS	INTERVALS		
	0-3 Months N=49	3-6 Months N=33	6-12 Months N=29
Information Content	.18	.19	.29
Fluency	.01	.09	-.06
Yes-No Comprehension	-.00	-.05	-.00
Word Recognition	.40**	.19	.09
Sentence Comprehension	.40**	-.11	.21
Repetition	.33*	.18	-.12
Object Naming	.39**	-.01	.34
Word Fluency	.14	-.10	.08
Sentence Completion	.28*	.13	-.07
Responsive Speech	.41**	.25	.37*
Aphasia Quotient	.33*	.26	.27
Reading	.45**	.35*	.09
Writing	.29	.08	.04
Praxis	.32*	.37	.14
Drawing	.37*	.04	-.01
Block Design	.18	-.47*	.45
Calculation	.10	-.13	-.05

* $p \leq 0.05$
** $p \leq 0.01$

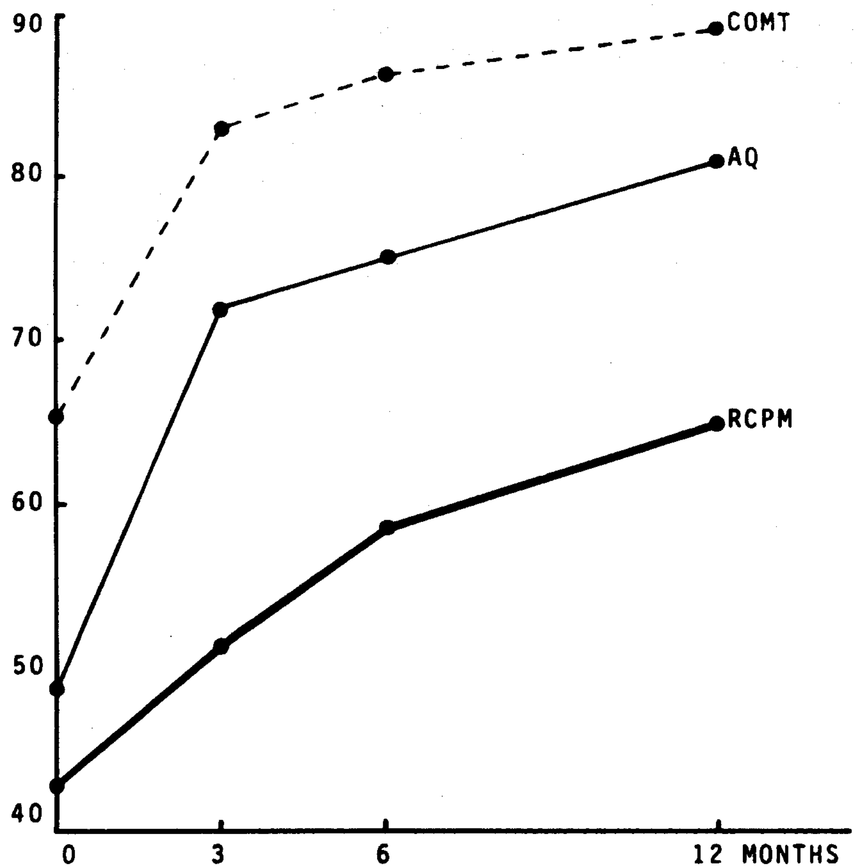

Figure 2. Recovery of visuospatial function and language by aphasic subjects.

Recovery from Apraxia

Recovery from Apraxia has not been documented in the literature so far. We followed 50 aphasic patients in 0-3 months and 13 patients in all intervals. We tested praxis with 20 commands for upper limb intransitive, (instrumental intransitive), buccofacial, and complex performances. Scoring was graded for acceptable, approximate or no performance, or on imitation and on object use. The results indicated that recovery of praxis closely paralleled language function in all aphasic groups (Figure 3). This confirms the notion that apraxia and aphasia are closely related and that recovery from damage causing apraxia is similar to that causing aphasia.

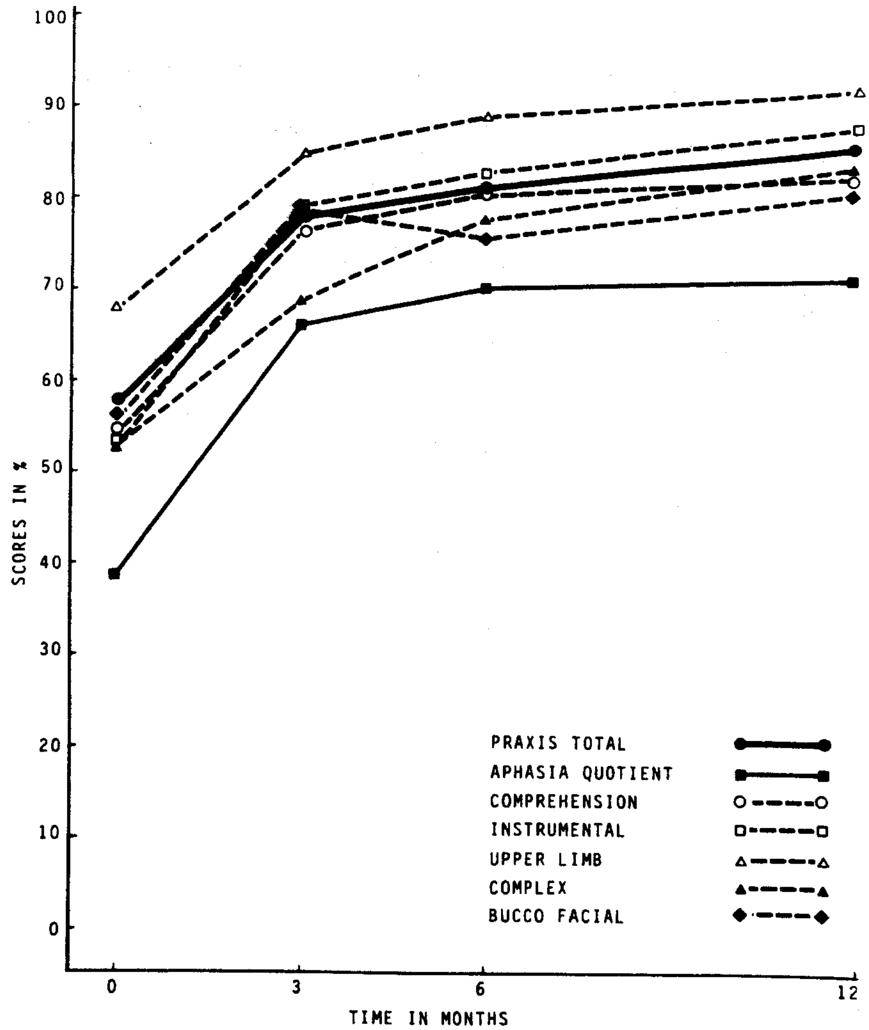

Figure 3. Recovery of praxis by 13 subjects followed for one year.

Lesion Size and Recovery in Aphasic Stroke

We have collected over 100 cases of aphasia with computerized tomographic localization who had follow-up examinations available. Sixty had 0-3 months and 32 had 0-12 months follow-up. In this study to be published in Brain and Language we calculated the extent of language recovery from the initial and one year scores on the Western Aphasia Battery; we then correlated the recovery rates with the lesion size as measured by a Hewlett-Packard digitizer. Table 6 shows the results. The positive correlation between recovery of comprehension and lesion size was the only one reaching statistical significance. A trend of negative correlation was observed for the other parameters. The reason is that the remarkable recovery of comprehension of some global aphasic subjects and severe Broca's aphasic subjects is often seen in large, middle cerebral artery lesions. These patients persist in their severely nonfluent, agrammatic aphasia but their comprehension will become functionally excellent. These patients are often labeled persistent severe Broca's aphasia, in the more chronic state. What seems to differentiate their lesions from those with persistent global aphasia and poor prognosis is the sparing of Wernicke's area on the C.T. scan.

Table 6. Language Recovery and Lesion Size.

PARAMETERS	PEARSON r	SIGNIFICANCE
AQ (Severity)	-0.253	N.S.
FLUENCY	-0.348	N.S.
COMPREHENSION	0.350	$p \leq 0.05$
REPETITION	-0.300	N.S.
NAMING	-0.255	N.S.

The trend of negative correlation for other parameters follows the usual clinical insight—the larger the lesion, the less the recovery. However, it is obvious from examining the individual cases, for example, in our published series of jargon aphasics (Kertesz and Benson, 1970), that a strategically placed small lesion can produce a severe, persisting aphasia. Conversely, large lesions which only partially involve the speech area will be compatible with substantial amount of recovery. These variables are quite common and decrease the degree of correlation.

The acute scans are most useful for the localization of areas producing the maximum disability and the chronic scans to determine the size of the lesion necessary to produce a final persisting deficit. When the patient is not examined in the acute state, interesting components of the language and the variations of acute syndromes which recover later are missed. The lesions may be much larger on the scan than necessary to produce the remaining deficit, and several overlapping lesions are required to determine the critical area.

Acute and chronic lesion sizes correlated well with each other, indicating that there is little, if any,change in the size of the infarct after it appears on the CT. The constancy of the lesion size in our study suggested that a CT image obtained in a chronic stable state is a good indication of the extent of the structural damage in the acute state, although effects of edema or other pathochemical or histological changes in the acute state may not be evident on the scans.

An important key to solve the continuing controversy in localization is to consider recovery, which often alters the clinical picture significantly while the lesion does not change in size. A knowledge of recovery patterns is essential to understanding how brain function and structure are related. With CT scans we have a new tool to explore degrees of functional compensation and relocation of speech mechanisms when relatively large areas of the brain remain destroyed.

Acknowledgment

Figures 2, 3, and Tables 4, 5, and 6 are from: Kertesz, A., Aphasia and Associated Disorders: Taxonomy, Localization, and Recovery. Grune and Stratton, New York, 1979.

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Discussion

Q: Has Dr. Kertesz collected data on recovery changes during months one, two, and three?
A: No, I haven't.

Q: It seems to me that the original definitions of the various kinds of aphasias were neurological definitions, because they had to do with site of lesion. Now it seems that the same labels are used in a behavioral sense, to describe the behaviors of various kinds of patients, and from those behaviors to diagnose sight of lesion.
A: I think your point is well taken. The classification terms that we use are a hodge-podge of psychological, behavioral, and linguistic terms. I think the key lies with careful testing of these patients, and careful comparisons of test results with our neurological diagnoses.

Q: It seems to me, Dr. Kertesz, that we might get into trouble using your test and the Boston classification system synonymously.
A: Our test is based on the Boston Examination and uses Boston subtests. It uses similar distributions of tests and similar emphases within subtests.

Q: I think that you said something about classifying patients for purposes of comparison. I think it's important to realize that that's the major purpose for classification, and that classification really does very little for treatment. For the speech pathologist, I think that description of the behaviors of patients who might fit into a particular classification is probably more important than the site of the lesion.
A: I fully agree. I think that one's classification system has to change according to the purpose for which you are using it.

Q: Dr. Kertesz, why did you exclude patients who had dysarthria from your study?
A: These patients were referred to us as aphasic, and the diagnosis was subsequently changed. They were excluded because they were dysarthric and not aphasic, and we were interested in aphasia treatment.

Q: Dr. Kertesz, can you refresh my memory regarding the changes in the aphasic syndromes over time?
A: I think that many of the changes occurred within the first three months. Some changes occur at six months, or even the one-year level, but by the time six months is up, you pretty much have your final outcome.