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Chronic aphasia and sensitivity to the training of semantic abilities: clinical evidences of a role of the right hemisphere in language recovery[1]

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Résumé

Lors d'une aphasie après accident vasculaire cérébral (AVC) sylvien gauche, la rééducation peut améliorer les performances langagières malgré la persistance de la lésion. Selon la "lateral shift hypothesis", cette récupération pourrait être sous-tendue en grande partie par les réseaux de l'hémisphère droit intact, où des capacités sémantiques ont été démontrées. Cette hypothèse a été testée chez trois patients aphasiques chroniques stabilisés de 60 (JHN), 64 (GE) et 40 (EG) ans, tous à plus de 3 ans de leur AVC. Ces patients ont bénéficié de 2 mois de thérapie intensive multimodale du langage selon un protocole d'étude de cas. Pendant un mois la thérapie était à orientation phonologique, et pendant un mois à orientation sémantique. Une évaluation aphasiologique préalable avait montré des difficultés sémantique et phonologique chez JHN, à prédominance sémantique chez GE, et à prédominance phonologique chez EG. L'amélioration chez JHN et EG n'était significative qu'après la thérapie sémantique et non après la thérapie phonologique. De plus, à la fin de l'ensemble de la thérapie, GE et JHN ont amélioré leurs performances en dénomination, mais non EG. Ces résultats suggèrent que les patients aphasiques chroniques peuvent bénéficier des effets d'une thérapie intensive, même plusieurs années après l'AVC, en particulier lorsqu'ils présentent encore des troubles sémantiques. L'amélioration de leur performances en dénomination semble dépendre plus de l'entraînement des déficits sémantiques que des déficits phonologiques. Un tel résultat est consistant avec un rôle important de l'hémisphère droit dans la récupération de l'aphasie.

Introduction

The neuropsychological theoretical models, and specifically the cognitive models, allow better focussing on the functional deficit of aphasic patients and are the basis of substantial progress in understanding aphasia and aphasia therapy (CARAMAZZA & HILLIS, 1993). They resulted in a refinement of language evaluation and in an improvement of targeting therapeutical interventions. Cognitive models have been widely used in therapy of reading and writing (DE PARTZ, 1986) but also in naming therapy (HILLIS, 1989).

However such therapy studies have not discussed to what extent recovery is based on brain plasticity, i.e. on the fact that other brain networks, particularly the right hemisphere, can take over certain functions. The nature of a possible right hemisphere speech production ability was first raised by Hughlings

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Jackson in the context of nonpropositional speech (JACKSON, 1879). The role of the right hemisphere in aphasia recovery has been much debated since the last century when Gowers noted that in a patient with recovered aphasia after a left brain lesion a subsequent right brain lesion again produced aphasic disturbances (GOWERS, 1887). The possibility that the right hemisphere can take over some linguistic capabilities of the left hemisphere (LH) has been called the "lateral shift hypothesis" (CODE, 1987). In its simplest form, it says that after left brain damage there is a shift of function to the undamaged right hemisphere (RH) for language processing. This hypothesis is supported by clinical reports and by some electrophysiological evidence. For example, in language tasks a stronger right hemisphere activation is seen in left brain damaged patients as compared to controls (MOORE, 1984; PAPANICOLAU et al., 1988). Dichotic listening experiments in aphasic subjects showed a greater left ear performance compared to that of the right ear performance as language abilities improved, supporting a "shift" of language dominance to the undamaged RH (PETIT & NOLL, 1979). The fact that the RH can participate in aphasia recovery implies that it has access to certain linguistic abilities which can be trained after LH damage. There are many observations that indicate a certain role of the RH in solving particular (especially semantic-related) language tasks. In normal subjects the RH plays a certain role in processing semantic aspects of language while other aspects, especially phonological ones, appear to be less represented in the right hemisphere (CODE, 1987; DREWS, 1987). Function words, which have few semantic features, are processed predominantly by the left hemisphere, while both hemispheres can collaborate in processing semantic features of words (MOHR et al., 1994).

Studies of brain damaged patients also suggest a certain role of the RH in semantic word processing. For example, a number of studies reviewed recently by Code (CODE, 1997) give evidence that the RH plays a major role in the production of aphasic speech automatisms. Studies of commisurotomised subjects indicate that the RH is able to comprehend common concrete nouns and recognises simple semantic associations (GAZZANIGA, 1970). Other studies of aphasic patients showed that after extensive LH lesions, language comprehension, and thus semantic processing, improved best (CUMMINGS et al., 1979). Patients with deep dyslexia, a reading disorder characterised by a predominance of semantic paralexias (e.g. chair for table) and an inability to read non-words and function words are thought to access the meaning of a word without reference to its phonology. In Coltheart's model, the patient has to process written words via the lexical route by accessing the RH lexicon

(COLTHEART, 1980). Another study of aphasic patients suggests that the presence of semantic paralexias is highly correlated with LH lesion size, patients with smaller LH lesions produce less semantic paralexia (LANDIS et al., 1983). On the other hand, right-handed patients with RH damage show deficient sentence completion but in a more pronounced manner than when processing of a context -i.e. semantic analysis- is required (EISENSON, 1973; GOULET & JOANETTE, 1994). In sum, experimental studies of normal subjects as well as clinical studies of brain damaged patients point to a semantic ability for concrete, imaginable words (JOANETTE et al., 1990) in the RH, contrasting with little or no graphophonemic and phonological processing capabilities.

These results raise the possibility that recovery of semantic language abilities in aphasic patients indeed does reflect a substantial contribution from the undamaged RH, especially with larger LH lesions. Indeed, CAPPA et al. (1997) showed that language recovery during the 6 first months was associated with the regression of functional depression in structurally unaffected RH regions. However, this hypothesis has been hardly tested and applied to rehabilitation and aphasia therapy. It would imply that the RH participates in language recovery with its "own" linguistic abilities, i.e. semantic abilities, and that recovery in aphasia is the result of a recovery of semantic abilities. This would predict that *i)* in a patient with semantic and phonological difficulties semantic therapy would be more efficient than phonological therapy and *ii)* aphasic patients with predominant semantic difficulties are more prone to improve than patients with predominantly phonological difficulties. We tested this prediction in three chronic aphasic patients with either residual semantic or phonological difficulties. These three patients had been dischared from therapy for more than a year when they participated in the therapy study. All three received the same phonological and semantic therapy. The first patient (JHN) had semantic and phonological difficulties. The two other aphasic patients differed in terms of linguistic difficulties: GE had residual difficulties in semantic access and EG in phonological access. Therapy-specific effects as well as global effects on naming performances were examined and compared between the three patients. A detailed description of the obtained results has been published elsewhere (ANNONI et al., 1998).

Patients and methods

The three patients had a chronic aphasia, as shown by the results obtained on the Boston Diagnostic Aphasia Examination at the end of clinical language

treatment and before participating in this experimental therapy study. They accepted to participate in the study between 1995 and 1996. They were examined and trained by the same speech therapist (MCC).

1) Patient JHN: a 66 year-old right-handed (OLDFIELD, 1971) medallist who was admitted to the Geneva University Hospital in April 1992 with an aphasia and a right hemiparesis. Investigations revealed a left fronto-insulo-lenticular stroke. The first language examination showed a non fluent aphasia, with very little oral expression, characterised by the presence of phonemic and semantic paraphasias and reduced written language abilities. Oral and written comprehension was possible only for simple orders. The pattern was consistent with a mixed aphasia according to Lecours's criteria (LECOURS & LHERMITTE 1979). He was treated for 18 months with traditional speech therapy (including semantic classification, naming, reading, writing tasks, and different cueing paradigms) 2-3 times a week. Comprehension recovered, oral expression to some extent; it remained characterised by the presence of semantic and phonemic paraphasias.

2) Patient GE: a 50 year-old right handed mechanic who presented in May 1988 a massive aphasia and right hemiplegia due to a left capsulo-lenticular stroke. The first language examination showed reduced oral expression and comprehension for both oral and written materials. The pattern was consistent with a non fluent Wernicke's aphasia (LECOURS & LHERMITTE 1979). This patient was treated for almost 3 years with a traditional therapy regimen (2-3 times/week). The aphasia evolved into a mixed type, with the persistence of slight comprehension deficits as well as semantic and phonemic paraphasias in spontaneous speech.

3) Patient EG: a 34 year-old right handed draftsman who in January 92 received a cardiac catether; due to an embolic stroke that affected the territory of the middle cerebral artery he suffered an aphasia and a right hemiplegia. The first language examination displayed a global aphasia (LECOURS &LHERMITTE 1979). He was treated for 2 years with traditional therapy therapy (2-3 times/week). Comprehension recovered and the aphasia evolved into a Broca's type with phonetic difficulties, low spontaneous fluency and word finding difficulties.

Language evaluation

As reported earlier, the general language evaluation consisted of a standard language battery, i.e. the French version of the Boston Diagnostic Aphasia Examination (BDAE, MAZAUX & ORGOGOZO, 1981). This test results in a

general language evaluation, based on the current clinical aphasiological approach, and measures characteristics such as overall severity, oral and written language production and comprehension, repetition, reading, naming, automatized language abilities, spontaneous fluency and music. Naming performance was also examined with a cognitive approach (BACHY-LANGEDOC, 1989). This tool consists of a general naming task involving 90 words and 5 other tasks, examining specific lexical effects (frequency, concreteness, prototypicality), physical characteristics (colour, type of presentations), effects of cueing and post-lexical (length) effect. We focussed on the presence of semantic and phonological paraphasias.

The patients' performance was characterised as revealing either a "lexico-semantic" or a "lexico-phonological" impairment by analyzing the access to semantic and phonological knowledge in a French reading battery, *l'évaluation des dyslexies acquises*, (EDA, LEMAY, 1990). The semantically oriented tests were designed to assess access to the meaning of the word and consisted in *i)* a semantic category word-out test in which the patient had to choose the alien word in a group of semantically related words, *ii)* a word-picture association test as standardised in the EDA where two semantically related written words have to be matched in the presence of a distracter visually similar but not related to the semantic target and *iii)* a semantic categorisation test. The phonologically oriented tests were designed to assess access to the form of a word and consisted in a phonemic discrimination test (LEMAY, 1990) in which the patient had to choose the alien word in a group of phonologically related words. This implied choosing the right word among *i)* vowel distracters, *ii)* consonant distracters and *iii)* visual distracters.

Therapies

The patients were treated 3 times a week during 1 month for each type of therapy. JHN and GE received first a phonological then a semantic treatment regimen, while EG first received semantically oriented and then phonologically oriented treatment. Between the two therapy types no treatment was given for 2 months .The treatment techniques were adapted from those which were proposed by HOWARD et al. (1985) and by LE DORZE et al. (1994). A multimodal type of therapy was used, with different domains like access to the orthographic, phonological, semantic lexicon, repetition, conversion systems, etc. According to the principles of interactive models, one can propose that semantic therapy will influence preferentially lexico-semantic processing whereas phonological therapy will result in lexico-phonological processing, but that the other system will also be trained and a global effect will appear (DELL,

1992). This advantage of using a variety of tasks is commonly found in clinical practice and is supported by controlled studies (BEST et al., 1997).

Semantically oriented multimodal therapy: the training focussed on 90 pictures (9 x 9 cm) of content words, different from the ones used in language evaluation, presented in 18 groups of 5 pictures. The pictures were generally taken from a classical collection of childrens' pictures (L'Imagier du Père Castor, 1977); only common concrete words were used. In each group there were 4 semantically related items and one semantically unrelated distracter; for example: *tournevis (screwdriver), tenailles (tongs), marteau (hammer), scie à métal (metal screw),* and the distracter ***canne (cane)***. The following tasks were trained during one session: naming with semantic distracters, pointing to picture from definition, written word-picture association, definition-picture association, word reading and repletion, word copy and writing to dictation, oral naming and written naming. Semantic or contextual cueing were used. Control training was always performed on the following session. Six groups of pictures were trained in each session so that all items were seen within one week. The same items were trained during 4 weeks. Feedback was given after each response and the question was repeated and cued until the response was correct.

The procedure was the following: for each set of pictures, the patient had to point to each item ("show me the screw-driver"); then to name it. Afterwards, he had to point to an item on oral definition ("show me the object used to take out a screw"). In written definition/picture matching, the definition was presented on a cardboard and the patient was asked to put it on the corresponding picture. Then, the written words were read and placed on the corresponding pictures. Finally, written naming was required.

Phonologically oriented multimodal therapy: the training focussed on 90 pictures (9 x 9 cm) of content words, different from the ones used in language evaluation, presented in 18 groups of 5 pictures. The pictures were again taken from the classical collection of childrens' pictures [L'Imagier du Père Castor, 1977]. The words were matched in length, frequency and concreteness with the content words used in semantic therapy. In each group there were 4 phonologically related items and 1 phonologically unrelated distracter (for example: *haricot ['aRiko], domino [domino], crapaud [kRapo], pinceau [pe~so]* and the distracter ***caisson [kEsÕ]***). The following tasks were trained: naming with phonological distracters, written word-picture association, word reading and repetition, word copying and writing to dictation, word completion, rhyme judgement. Phonological and orthographic cueing were used. As in semantic therapy, control training was always performed on the following

session and six groups of pictures were trained in each session. The same items were trained during 4 weeks. Again, feedback was given for each response and the question was repeated and cued until the response was correct.

The procedure was the following: for each set of pictures, the patient was asked to point to the item named by the therapist. The same items were then named by the patient. Reading and repetition of the corresponding words was trained. Afterwards, the patients had to find the alien (non rhyming) word. In written word/picture matching, the written name was presented on a cardboard and the patient was asked to place it on the corresponding picture. For each item, a sound decision was asked (for example, the item representing a bean/*haricot ['aRiko]* was shown and the following question was asked: "Is the sound *[k]* present in the word corresponding to this picture?"*)*. Then, the words had to be copied and written to dictation.

Effects of therapy

Although therapy affected all language modalities, the effect was only evaluated for naming performance. In a first step the specific effect of each type of therapy on naming performance was measured in each patient and in a second step, the global effects of the total therapy procedure was determined and compared between patients. Improvement of naming performance was measured by comparing pre-therapy and post-therapy performance in a validated French version of the Boston Naming Test (BNT) (COLOMBO-THUILLARD & ASSAL 1992). This shorter version of the BNT, already used to evaluate the level of these patients after the end of their previous post-stroke language therapy, has two equivalent sets of pictures and offers the possibility of a test-retest procedure. The score obtained on the BNT (transformed to the equivalent score of the original version) was based on the number of correctly named stimuli. Pre-therapy baseline was determined three weeks before the beginning of the first session of therapy using the BNT and results were compared to the performances of the three patients in the same test obtained at the end of the previous post-stroke speech therapy (6 months before for JHN and EG and 1 year before for GE), in order to ensure the stability of naming performance. Post-therapy measurements were done 3 weeks after the end of each experimental therapy. Statistical analyses between each pre-therapy score and post-therapy score were carried out with a chi-2 non parametric test. A long-term control test was performed 6 months after the end of the study.

Results

A) Patient Characteristics

During the baseline evaluation before controlled therapy, the three chronic patients showed good residual language abilities, both in spontaneous and test situations. When naming was analyzed, the frequency effect was clearly significant for GE and EG and approached significance for JHN. This effect is consistent with a lexical deficit in all three patients. However, the patients differed in their residual "lexical-semantic" and "lexical-phonological" impairments; JHN was the most impaired. The patients were characterised according to their residual "lexico-semantic" and "lexico-phonological" impairment by analyzing their access to semantic and phonological knowledge.

a) JHN: more than 3 years after the stroke, he scored in the normal range in nearly all the subtests of the French version of the Boston Diagnostic Aphasia Examination (BDAE), except in a verbal fluency subtest and in comprehension of spelled words. The general severity rating was 3 out of a maximum of 5. In the oral naming battery he produced 13.5% semantic errors and 12.4% phonemic errors out of a total of 251 items. In reading tasks, he showed more difficulties in reading words (32/48) than non words (44/48). JHN had also a difficulty in repetition. JHN performed equally at the semantically-oriented tests and phonologically-oriented tests (table 1), making a small number of errors in each test. This pattern pointed to the equal presence of semantic and phonological difficulties.

b) GE: in the BDAE, he showed some paraphasias, insufficient results in fluency subtests, repetition of concrete sentences, comprehension of spelled words and automatic writing. The general severity rating was 3 out of a maximum of 5. In the oral naming battery he produced 9.2% semantic errors and only 3.6 % phonemic-phonetic errors out of a total of 251 items. In reading tasks, he showed enormous difficulties in reading nonwords (19/48) compared to words (45/48). GE performed significantly worse in the semantically-oriented tests than in phonologically-oriented tests (table 1). This pattern indicates a predominance of semantic difficulties.

c) EG: the performances in the BDAE were characterised by some insufficient results in a verbal fluency subtest and in comprehension of spelled words. The general severity rating was 4 out of a maximum of 5. In the oral naming battery he produced only 4.8% semantic errors and 1% phonemic errors out of a total of 251 items. However, a closer examination of the results showed

that EG self-corrected all the semantic errors. EG also showed no concreteness effect. Moreover, in the written naming task of the BDAE and in our own written naming tasks, he produced no semantic errors, which was not the case for the 2 other patients. He showed no difficulties in reading words (48/48) and moderate difficulties for nonwords (36/48). EG performed significantly worse in the phonologically-oriented tests than the semantically-oriented tests (table 1). This pattern lets us consider EG as presenting essentially difficulties in accessing the phonological form of the word even though there were some semantic paraphasias in the naming task.

Table 1: Semantic and phonological errors in the semantically oriented test and in the phonologically oriented test. The number indicate the total number of errors in the 3 semantic and phonological tests. Statistics were calculated within subjects.

	J.H.N	**G. E.**	**EG**
Semantic errors	2/37	4/37	0
Phonological errors	4/36	0/36	5/36
Difference	chi2=0.8, p=.37	chi2=4.3, p<.04	chi2=8.3, p<.004

B) Effect of therapy

There was no effect of either phonological or semantic therapy on the naming performances of the materials used in therapy. The only patient in whom improvement reached significance with both material was GE. However, the trained items were frequent concrete items that were familiar to the patient, initial performances tended to show a "ceiling effect". The patients were also familiar with general therapy material, due to their previous post-stroke aphasia rehabilitation.

Performance on the French adaptations of the Boston Naming Test (BNT) was then considered: JHN's improvement in performance was assessed with the BNT 3 weeks after the phonological and 3 weeks after the semantic therapy. The results show some improvement after both therapies, but this improvement was significant only after semantic therapy (table 2). A comparable level of

performance was noted 3 months later. There was a significant improvement in GE after semantic therapy, but not after phonological therapy. EG did not significantly improve after semantic nor after phonological therapy (table 2).

A further analysis focussed on GE's and EG's global changes in performance on the BNT after the 3 months in which both semantic then the phonological therapies were given. The overall improvement in naming performances on the BNT was significant only for GE (table 2). A control administration of the BNT was given 6 months after the end of the therapy and showed both patients performing on a similar level as 3 weeks after therapy.

Table 2: Baseline scores and changes in naming performances on the Boston Naming Test (BNT) after semantic and phonological therapy.

	JHN (semantic then phonological therapy)	**G.E. (semantic then phonological therapy)**	**E.G (phonological then semantic therapy)**
Performance before entering study	*25/73*	*53/73*	*62/73*
Baseline (performance immediately before therapy)	18/73	57/73	59 /73
Semantic therapy	+18* (chi2=8.89, p=.003)	+ 8* chi2=4.06, p=.04)	+0 (chi2=0, p=1)
Phonological therapy	+8 (chi2=2.08, p=.15)	+3 (chi2=.039, p=.53)	+5 (chi2=1.29 p=.25)
Total score (total changes) at the end of TTT	44/73 [+26*] (chi2=18.95, p<.001)	68/73 [+11*] (chi2=6.7, p=.01)	64/73 [+ 5] (chi2=1.29 p=.25)
Follow-up(6 mo)	*41/73*	*68/73*	*64/73*

Discussion

The main results obtained in this study concern the capacity of chronic aphasic patients to improve their naming abilities more than three years after their stroke. The main results can be summarised as follows:

i) When semantic and phonological therapy are given to JHN, an aphasic patient with semantic and phonological deficits, only semantic therapy significantly improved his performances on a naming task unrelated to the therapy material.

ii) When the global effect of both semantic and phonological therapies are considered in the two other aphasic patients (GE and EG) who presented either mainly semantic or phonological deficits, only the patient with semantic deficit improved significantly his naming performances.

The choice of chronic patients with a stable aphasia allows improvements to be attributed to treatment and not to spontaneous recovery.ed to discard spontaneous recovery. The absence of spontaneous recovery was confirmed in controlling previous performances at the end of the "classical language rehabilitation" and 3 to 6 months after this study. The results suggest also that even in chronic patients intensive therapy may be worthwhile. Due to the long post-onset interval the overall changes in naming tasks turned out to be small. On the other hand, the results are not due to a test-retest effect. The words used in the therapies are different from those used in the naming tasks, and two different versions of the BNT were used.

These results suggest that working on semantic deficits, when they are present, can improve naming abilities of chronic aphasic patients. Thus, semantic abilities, which implicate both hemispheres, are more prone to be trained in naming therapy than phonological abilities. These results are in agreement with the hypothesis that language recovery can benefit from RH mediated linguistic abilities. This advantage of semantic therapy seems to be related to the fact that lexico-phonological therapy results in item-specific effects, while semantic therapy may generalise to untreated items (HILLIS, 1989). However, in the present study, post-hoc analyses in the 3 patients did not lead to a consistent effect of the phonological therapy on trained words. Our results support the ones presented by HOWARD et al. (1985) who compared semantic and phonological therapy, and reported that semantic therapy was slightly better than the phonological one. However our study has concentrated on long term effects (1 and 6 months) while Howard examined mostly short-

term priming effects (after 24 hours). In a single case experiment, BEST et al. (1997) compared lexico-semantic and lexico-phonological therapies in an aphasic patient, JOW, whose semantic access was intact. In contrast with their expectations, naming did not benefit from the lexical therapy but was improved by the semantic therapy.

The other important finding in our study is the fact that the overall therapy was more effective in a patient with semantic difficulties than in one with phonological difficulties. According to the interactive models of language production (HARLEY, 1993), one would have expected a similar global effect in both patients (GE and EG). Our results suggest that in chronic aphasics naming abilities can be significantly improved by a global therapy only when the patients also present semantic impairments and not when they have pure phonological difficulties. This finding points to the necessity, as already previously proposed (NETTLETON & LESSER, 1991), to tailor therapy to the specific deficits of the patients.

The fact that EG did not improve could also be due to his higher pre-therapy score, i.e. ceiling effect. This explanation does not hold since GE's post-therapy score was higher than EG's. Another possibility is that the size of the lesion and age of the patients, played a role in recovery (KERTESZ, 1977). Concerning the age, the older patients (JHN and GE) improved more than the younger one (EG). Considering the size of the lesions, it is noteworthy that EG, who has the larger lesion showed a similar overall recovery until the time of this controlled therapy as GE who presented a smaller lesion. In addition, in JHN the difference between the effect of semantic and phonological therapy could not be attributed to the lesion, since it was measured in the same patient. Moreover, JHN improved better after the therapy than GE, despite his larger lesion. The present observations indicate that, as recently reported (BASSO & FARABOLA, 1997), the size of the lesion can't be considered as the unique predictor of post-stroke aphasia recovery.

Considering the present results, it is reasonable to assume that the observed effects of the semantic therapy were at least partially due to RH linguistic abilities, which, as described in the introduction, are involved in semantic tasks. This hypothesis would thus account for the improvement observed in JHN after semantic therapy but also for the global effect of therapies in the patient with semantic impairment (GE) as opposed to the one presenting phonological impairment (EG). In line with this hypothesis, several clinical and experimental data (see introduction) suggest that the RH may have some access to semantic knowledge. Moreover, this participation is also suggested by functional brain

mapping studies in aphasic patients (OHYAMA et al., 1996). However, this possible implication of the RH in aphasic patients is not unitary and seems to depend on the type of the linguistic task. For example, Melodic Intonation Therapy, which is specifically supposed to activate the right hemisphere, induces a PET activation of Broca's area and a deactivation of the RH in aphasic patients, suggesting more complex interhemispheric interaction (BELIN et al., 1996). Event-related potentials in left brain damaged patients obtained during semantic judgement tasks and analysed in terms of 3-D current density distribution suggested that RH activation is dependent on the visual field in which words are presented (MICHEL et al., 1997).

In conclusion, our results show that some chronic aphasic patients may improve their linguistic abilities even many years after the stroke. This improvement seems to be related mostly to training of semantic abilities, a finding which may be in accordance with the role of RH linguistic abilities in aphasia recovery, despite the absence of any direct evidence in our study. Such a hypothesis may be taken into account when planning rehabilitation, especially if the patients present multiple deficits. It represents a complementary approach to cognitive models which are most interesting in patients with only single deficits. This investigation forwards an alternative view. Cognitive Neuropsychology, which is completely oriented toward the functional deficit of the patient, has led to substantial progress in aphasia and aphasia therapy (CARAMAZZA & HILLIS, 1993). However, its application is most interesting in patients where only specific deficits remain and more difficult to apply in our three patients who possess multiple deficits. In such a situation, only a therapeutical approach which takes into account possible compensatory mechanisms of the brain is useful. This approach must be used in chronic patients if we assume that learning abilities of functionally non-specific intact brain areas are independent of time post onset.

References

ANNONI, J.M., KHATEB, A., CUSTODI, M.C., DEBEAUVAIS, V., MICHEL, C.M. & LANDIS, T. (1998): "Advantage of semantic therapy in chronic aphasia and semantic abilities: a study on three cases", *Aphasiology,* in press.

BACHY-LANGEDOCK, N. (1989): *Batterie d'examen des troubles de la dénomination*, Editest, Bruxelles.

BASSO, A. & FARABOLA, M. (1997): "Comparison of improvement of aphasia in three patients with lesions in anterior, posterior and antero-posterior language areas", *Neuropsychological Rehabilitation*, 7, 215-230.

BELIN, P., VAN EECKHOUT, P., ZILBOVIVIUS, M., REMY, P., FRANÇOIS, C., GUILLAUME, S., CHAIN, F., RANCUREL, G. & SAMSON, Y. (1996): "Recovery from nonfluent aphasia after melodic intonation therapy: a PET study", *Neurology*, 47, 1504-1511.

BEST, W., HOWARD, D., BRUCE, C. & GATEHOUSE, C. (1997): "Cueing the words: a single case study of treatment of anomia", *Neuropsychological Rehabilitation,* 7, 105-141.

CAPPA, S.F., PERANI, D., GRASSI, F., BRESSI, S., ALBERONI, M., FRANCESCHI, M., BETTINARDI, V. & FAZIO, F. (1997): "A PET follow-up study of recovery after stroke in acute aphasics", *Brain and Language,* 56, 55-67.

CARAMAZZA, A. & HILLIS, A.E. (1993): "For a theory of rehabilitation", *Neuropsychological Rehabilitation,* 3, 217-234.

COLTHEART, M. (1980): "The semantic error: types and theories". In: M. CLOTHEART, K. PATTERSON & J.C. MARSHALL (Eds), *Deep dyslexia,* London, Routledge & Kegan Paul, 146-159.

CODE, C. (1987): *Language, aphasia and the right hemisphere*, New York, John Wiley & Sons.

CODE, C. (1997): "Can the right hemisphere speak?", *Brain & Language,* 57, 38-59.

COLOMBO-THUILLARD, F. & ASSAL, G., (1992): Adaptation française du test de dénomination de Boston: version abrégée, *Revue Européenne de Psychologie Appliquée*, 42, 67-74.

CUMMINGS, J.L., BENSON, J.L., WALSH, M.J. & LEVIN, J.H. (1979): "Left to right transfer of language dominance: a case study", *Neurology*, 29, 1547-1550.

DELL, G.S. & O'SEAGHDHA, P.G. (1992): "Stages in sentence production: an analysis of speech error data", *Journal of Verbal Learning and Verbal Behavior*, 20, 611-629.

DE PARTZ, M.P. (1986): "Reeducation of a deep dyslexic patient. Rationale of the methods and results", *Cognitive Neuropsychology*, 3, 149-177.

DREWS, E. (1987): "Qualitatively different organizational structures of lexical knowledge in the left and right hemisphere", *Neuropsychologia*, 25, 419-427.

EISENSON, J. (1973): *Adult aphasia.* New Jersey, Prentice Hall.

GAZZANIGA, M.S. (1970): *The bisected brain.*, New York, Appleton Century Croft.

GOULET, P. & JOANETTE, Y. (1994): "Sentence completion task in right-brain dammaged right-handers: Eisenson's study revisited", *Brain and Language*, 46, 257-277.

GOWERS, W.R. (1887): *Lectures in the diagnosis of diseases of the brain,* Philadelphia, Blakiston.

HARLEY, T.A. (1993): "Connectionist approaches to language disorder", *Aphasiology*, 7, 221-249.

HILLIS, A.E. (1989): "Efficacy and generalisation of treatment for aphasic naming errors, *Archives of Physical Medicine and Rehabilitation,* 70, 632-636.

HOWARD, D., PATTERSON, K., FRANKLIN, S., ORCHARD-LISLE, V. & MORTON, J. (1985): "Treatment of word retrieval deficits in aphasia", *Brain*, 108, 817-829.

JACKSON, H.J. (1879): "On affections of speech from disease of the brain", *Brain*, 2, 203-222.

JOANETTE, Y., GOULET, P. & HANNEQUIN, D. (1990): *Right hemisphere and verbal communication*, New York, Springer Verlag.

KERTESZ, A. (1977): "Recovery pattern and prognosis in aphasia", *Brain*, 100, 1-18.

LANDIS, T., REGARD, M., GRAVES, R. & GOODGLASS, H. (1983): "Semantic paralexia: a release of right hemispheric function from left hemisphere control", *Neuropsychologia*, 21, 359-364.

LE DORZE, G., BOULAY, N., GAUDREAU, J. & BRASSARD, C. (1994): "The contrasting effect of semantic versus a formal semantic technique for the facilitation of naming in a case of anomia", *Aphasiology*, 8, 127-141.

LEMAY, M.A. (1990): *Examen des dyslexies acquises,* Montréal, Les éditions Point Carré.

LECOURS, A.R. & LHERMITTE, F. (1979): *L'aphasie*, Paris, Flammarion.

L'Imagier du Père Castor (1977): Paris, Flammarion.

MAZAUX, J.M. & ORGOGOZO, J.M. (1981): *Boston diagnostic aphasia examination,* Paris, Editions Scientifiques et Psychologiques.

MICHEL, C. M., KHATEB, A., CUSTODI, M. C., ANNONI, J. M., SEEK, M. & LANDIS, T. (1997): "Neural networks of language processing: real-time evoked potential tomography in normal and patients with left hemisphere lesion", *Neurology*, 48, A306.

MOHR, B., PULVERMÜLLER, F. & ZAIDEL, E. (1994): "Lexical decision after left, right and bilateral presentation of function words, content words and non-words: evidence for interhemispheric interaction", *Neuropsychologia*, 32, 105-124.

MOORE, W.H. (1984): "The role of right hemispheric information processing strategies in language recovery in aphasia: an electroencephalographic investigation", *Cortex*, 20,193-205.

NETTLETON, J. & LESSER, R. (1991): "Therapy for naming difficulties in aphasia: application of a coginitive neuropsychological model", *Journal of Neuropsycholinguistics,* 6, 139-157.

OHYAMA, M., SENDA, M., KITAMURA, S., ISHII, K., MISHINA, M. & TERASHI, A. (1996): "Role of the nondominant hemisphere and undamaged area during word repetition in poststroke aphasics. A PET activation study", *Stroke*, 27, 897-903.

OLDFIELD, R.C. (1971): "The assessment and analysis of handedness: The Edinburgh Inventory", *Neuropsychologia*, 9, 97-113.

PAPANICOLAU, A.C., MOORE, B.D., DEUTSCH, G., LEVIN, H.S. & EISENBERG, H.M. (1988): "Evidence for right hemisphere involvement in recovery from aphasia", *Archives of Neurology,* 45, 1025-1029.

PETIT, J.M. & NOLL, J.D. (1979): "Cerebral dominance in aphasia recovery", *Brain and Language,* 7, 191-200.