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Reading and writing disturbances in Spanish: Evidence for a universal neurolinguistic model of reading and writing.

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Abstract

Psycholinguistic studies in English and French about the reading and writing behavior of patients with brain lesion point towards the existence of subtypes of acquired dyslexias and dysgraphias. From these observations various models of the reading and writing processes in the brain have been proposed. According to these models, we have at our disposal at least two routes to read and write a word: one at the global or lexical level, and another at the sublexical level. It is recognized too that, among other factors, the orthographic structure of a language plays a crucial role in the selection of the route to access the meaning and pronunciation of a word. One of the most specified models of reading and writing, incorporating orthographic structure as a relevant aspect of these processes, is that of Lecours (1996). Based on his model, he proposed an evaluation protocol to test reading and writing disturbances in French. Following Lecours (1996), we developed a reading and writing testing protocol to evaluate dyslexia and dysgraphia in Spanish, and we found that in Spanish there are the same subtypes of dyslexias and dysgraphias described for other languages. Our findings contradict Ardila's claim that lexical reading is not an option for Spanish speakers due to the nature of the orthographic structure of the language (Ardila, 1991; Ardila, Rosselli and Pinzón, 1989). We conclude, first, that Lecours' model is an adequate universal neurolinguistic model of reading and writing, and, second, that with the appropriate set of hypotheses provided by a model, valid testing procedures, and the appropriate linguistic criteria for the selection of stimuli, the universality of the cognitive processes of reading and writing can be proven.

Résumé

L'objectif de cette étude était celui d'explorer la possibilité qu'en espagnol –une langue réputée pour la régularité de sa structure orthographique- nous puissions observer les mêmes syndromes dyslexiques et dysgraphiques décrits pour des langues telles que le français, l'anglais et le japonais, des langues dont la structure orthographique montre divers degrés d'irrégularité. Une des prémisses de base de cette étude est que les processus cognitifs mis en jeu dans la lecture et l'écriture sont universels, c'est-à-dire, qu'ils sont les mêmes pour tous les êtres humains indépendamment de leur langue et de leur système d'écriture.

Le terme "dyslexie" est utilisé pour décrire une difficulté de lecture caractérisée par un niveau de lecture en dessous de celui qui correspond à l'âge et au parcours éducatif de l'individu et qui ne peut pas être expliqué en termes d'handicap intellectuel ou de trouble sensoriel (Mora et Sanguinetti, 1994). Cette thèse portera en particulier sur ce qui est appelé "dyslexie acquise"[1] et qui correspond à la perte ou la détérioration du sens en lecture comme conséquence d'une lésion cérébrale, et sur la "dysgraphie acquise", qui est le problème équivalent en écriture. Il y a plusieurs analyses et classifications de dyslexies et d'agraphies acquises. Cependant, dans les trois dernières décennies, grâce aux travaux pionniers de Marshall et Newcombe (1966; 1973) et Beauvois et Dérouesné (1979), une analyse psycholinguistique des dyslexies et des agraphies a été développée donnant origine à de nombreuses études en anglais et en français. Selon les résultats obtenus par ces chercheurs, on postule qu'il y a au moins trois types principaux de dyslexies : la dyslexie profonde, la dyslexie de surface et la dyslexie phonologique. Ces syndromes nous permettent de décrire les difficultés de lecture qui iraient dès les problèmes d'accès à la prononciation d'un mot à partir de sa représentation graphique aux problèmes d'accès au sens d'un mot à partir de sa forme écrite.

Marshall et Newcombe (1966, 1973) ont rencontré chez leurs patients deux modèles d'erreur ou paralexies [2]. Ils ont constaté qu'il y avait un groupe de patients qui ont tendance

[1] D'autre part, le terme "dyslexie du dévelopment" fait référence à la difficulté d'apprendre à lire, malgré un intelligence adéquate, une instruction et un niveau socio-culturel (Hynd Cohen, 1987)

[2] Nous entendons par "paralexie" les transformations erronées des symboles linguistiques. Cela peut se passer à des niveaux différents, par exemple : une "paralexie littérale" fait référence au remplacement erroné d'une

à comettre les types d'erreur suivants : i) des paralexies sémantiques, c'est-à-dire, qu'ils remplacent le mot stimulus par un autre mot qui garde un rapport de sens avec celui-ci, par exemple, ils pouvaient lire "bonheur" à la place de "joie"; ii) des erreurs dérivées, c'est-à-dire, qu'ils lisent correctement le radical d'un mot stimulus mais avec un affixe incorrect; par exemple, ils pouvent lire "vrai" au lieu de "vraisemblable", et iii) des paralexies visuelles, c'est-à-dire, qu'ils remplacent un mot par un autre visuellement semblable à celui-ci mais sans aucun rapport avec, par exemple, le mot "place" par "glace". D'autre part, il y avait un autre groupe de patients qui –quand ils lisaient des mots avec une écriture irregulière, ils pouvaient faire des erreurs qui semblaient en rapport avec une inattention du contexte graphémique des lettres et ils avaient tendance à remplacer le mot pour une forme phonologique plausible tenant compte des graphèmes, mais avec une forme sémantiquement inexistante. Par exemple, le mot "étudiant" était lu /esdutian/. Marshall et Newcombe ont appelé ce premier syndrome "dyslexie profonde" et le second "dyslexie superficielle". Ils affirmaient que les difficultés initiales de lecture pouvaient trouver leur origine dans l'inadéquation de la voi phonologique et par conséquent, le patient aurait besoin de revenir à la voie directe ou sémantique, ou de la forme imprimée à la signification pour pouvoir lire. Le second syndrome était expliqué par le modèle opposé, c'est-à.-dire, comme il y avait inadéquation de la *voie* sémantique, ils avaient besoin d'établir un lien seulement de la voie phonologique, ou de la forme imprimée à la prononciation.

Plus tard Beauvois et Déreousné (1979) ont décrit un autre syndrome qui ne correspondait pas aux modèles établis par Marshall et Newcombe. Ces patients pouvaient lire des mots avec une orthographe tant régulière qu'irregulière, pourtant les mots avec une haute fréquence étaient lus mieux que ceux avec une basse fréquence, mais ils éprouvaient une grande difficulté avec les mots non familiers ou les pseudomots[3]. Ces chercheurs ont appelé ce syndrome "dyslexie phonologique".

Ces trois syndromes se sont avérés beaucoup plus complexes de ce que l'on pensait au début et ils seront décrits d'une manière plus détaillée dans le chapître suivant.

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lettre par une autre. D'autre part, un "paralexie lexicale" fait référence à la substitution erronée d'un mot par un autre, etc. (Lecours, Lhermitte et Bryan, 1983). Une classification des paralexies tel qu'elles ont été définies pour cette étude seront expliquées en détail dans le chapître suivant.

[3] Les pseudomots ce sont des séquences de lettres qui n'appartiennent pas au lexicon d'une langue mais qui ne violent ni la structure syllabique ni les contraintes phonologiques et qui n'ont pas de contenu sémantique.

Cependant, leur description et conceptualisation ont été très productives car elles ont fourni des hypothèses et des modèles à confronté aux des observations empiriques. Ceci a permis d'établir de nouveaux modèles de lecture et d'écriture et à améliorer ceux qui existaient déjà. L'observation que ce sont des patients qui semblent avoir des difficultés à accéder à la prononciation d'un mot écrit mais non pas d'atteindre sa signification (ou sa signification partielle), et qu'il y a des patients qui montrent le comportement opposé, a donné origine aux modèles de lecture et d'écriture appelé de "*double voie*". Ces modèles ont été construits sur la base des études de patients anglais et français. La structure orthographique de ces langues est telle que fréquemment la prononciation d'un graphème dépend de son contexte, c'est-à-dire, que l'anglais et le français ont une orthographe "irregulière" ou "opaque". D'autre part, l'orthographe de l'espagnol est assez "régulière" ou "transparente" dans le sens qu'avec très peu d'exceptions, les graphèmes ont toujours la même prononciation.

Ardila et ses collègues (Ardila, 1991; Ardila, Rosselli et Pinzón, 1989) affirment que la lecture lexicale n'est pas une option pour les lecteurs de l'espagnol à cause de la transparence de l'orthographe de la langue. D'après ces chercheurs, lire l'espagnol demande toujours d'utiliser une décodification phonologique: "Pour les hispanophones, l'opération cognitive principale pendant la lecture est de transformer les graphèmes en phonèmes. Notre point est simplement que lire en anglais et lire en espagnol représente des activités cognitives assez différentes. Par conséquent, la représentation de la langue écrite dans le cerveau et les modèles pour les alexies et les agraphies doivent être aussi assez différents" (Ardila, Rosselli et Pinzón, 1989, p. 173, traduit par I.C.Iribarren). Pourtant, nous reconnaissons qu'une langue et sa structure orthographique jouent un rôle important dans la lecture et l'écriture. Cependant nous pensons qu'au lieu d'être un problème au niveau cognitif, il s'agit d'un problème de prémisses et de méthodologie dans l'évaluation des déficits de lecture et d'écriture chez les hispanophones. Ellis (1985) signale que puisque l'écriture est une invention récente du point de vue évolutif (et son emploi généralisé est plus récent), il est peu probable que dans notre carte génétique nous ayons des structures spécialisées spécifiquement pour traiter n'importe quel système d'écriture.

Pour évaluer cette hypothèse, nous avons basé notre recherche sur le modèle et le protocole d'évaluation pour les dyslexies et les agraphies en langue française développé par A.R. Lecours tel qu'il apparaît dans son livre intitulé Langage Écrit : Histoire, théories et

maladies (Isbergues : Ortho, 1996). Nous avons choisi ce modèle parce qu'il s'agit d'un des modele les plus spécifiques par rapport au sous-processus mis en jeu dans la lecture et l'écriture et parce qu'il offre la possibilité de tester les variations dans les systèmes d'écriture et des structures orthographiques dans différentes langues. Afin d'évaluer systématiquement les différents sous-processus qu'on considère comme faisant partie de la lecture et l'écriture, il est impérieux d'utiliser un modèle qui décrit et organise ces constituents d'une manière cohérente. Le modèle de Lecours décrit explicitement le sous-processus concerné dans les voies lexicale et sous-lexicale pour la lecture et l'écriture. Sur la base de ces postulats il a développé les tests spécifiques à la langue française pour vérifier l'état de chaque voie à des niveaux différents chez des patients aphasiques. En suivant cette ligne de travail, nous avons développé un protocole d'évaluation pour les dyslexies et les dysgraphies en espagnol en tenant compte des caractéristiques linguistiques de cette langue et à des niveaux de représentation de sa structure orthographique. Quand il est possible de le faire, nous utilisons les tests de Lecours traduits à l'espagnol, mais dans certains cas nous avons développé nos propres tests tenant compte des caractéristiques particulières de cette langue. L'adaption à l'espagnol est ainsi de nous. Le modèle de Lecours et le protocole d'évaluation pour le diagnostique des dyslexies et des agraphies en espagnol sera décrit en détail dans les chapîtres 3 et 4, respectivement.

En utilisant ce protocole d'évaluation pour les dyslexies et les dysgraphies en espagnol, nous avons testé nombre de patients et nous avons trouvé les mêmes modes de lecture et d'écriture que ceux décrits pour d'autres langues. Certains patients semblaient avoir des difficultés à accéder à la signification des mots à partir de la forme écrite (dyslexie de surface), d'autres semblaient avoir des difficultés pour atteindre la prononciation des mots, même s'ils montraient une certaine compréhension de ces mots (dyslexies profonde), et il y avait un groupe de patients qui semblaient avoir des problèmes particuliers avec des pseudomots (dyslexie phonologique). De ces patients, nous avons choisi les cas de ceux qui avaient complété le protocole d'évaluation et qui montraient des perturbations de lecture et d'écriture bien définies et nous les avons présentés dans les articles de revue spécialisés. Ces articles font partie du corps de cette thèse. Ils correspondent aux chapîtres 5, 6 et 7.

À la lumière de la comparaison du comportement de lecture et d'écriture de ces patients, il sera évident que les différentes dissociations observées nous orientent vers la confirmation qu'en espagnol il y a les mêmes syndromes que ceux signalés pour les autres langues. Si l'irrespect de la structure orthographique et les mêmes syndromes dyslexique et dysgraphique peuvent être observés, alors nous pouvons affirmer que les processus cognitifs sousjacents à la lecture et à l'écriture ne sont pas spécifiques à une langue, comme le suggéraient Ardila et ses collègues, mais ils doivent être "universaux". Nous concluons que le modèle de Lecours est un modèle neurolinguistique universel adéquat pour la lecture et l'écriture et qu'avec des procédures d'évaluation et des critères linguistiques appropriés à la sélection du stimulus, l'universalité des processus cognitifs de lecture et d'écriture peut être confirmé.

Un résultat dérivé de cette étude était le développement d'un protocole d'évaluation pour les sous-types des dyslexies et des dysgraphies acquises, spécifiquement pour l'espagnol au Venezuela. Nous devons faire mention du fait qu'au début de cette étude nous avons rencontré des orthophonistes qui travaillaient avec une bonne disposition mais sans l'entrainement ni les instruments de travail appropriés auprès de patients adultes qui avaient eu une expérience accablante de perte de leur capacité de lecture et écriture. Même si nous considérons que ce protocole d'évaluation peut être amélioré de différentes manières, nous espérons qu'il sera utile pour l'évaluation et le diagnostique de ces sous-types de dyslexies et des dysgraphies en espagnol, et qu'il permettra d'améliorer les programmes thérapeuthiques de ces patients.

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Chapter 1:
Introduction.

The purpose of this study was to explore the possibility that in Spanish, a language known for the regularity of its orthographic structure, we could observe the same dyslexic and dysgraphic syndromes described for languages like French, English and Japanese, languages whose orthographic systems show various degrees of irregularity. One of the basic assumptions of this study is that the cognitive processes involved in reading and writing are universal, that is, that they are the same for all human beings irrespective of their language and writing system. However, some differences have been found across languages. The writing system used by a language has repercussions in the manner the different dyslexic and dysgraphic syndromes are observed.

Dyslexia is the term used to describe a reading difficulty characterized by a reading level below that which would correspond to the age and educational history of the individual and that cannot be explained in terms of mental retardation or sensory impairment (Mora and Sanguinetti, 1994). This thesis will focus mainly on what is known as "acquired dyslexia,"[1] meaning reading loss or deterioration as a consequence of brain injury, and "acquired dysgraphia," the equivalent problem in writing. There are various analyses and classifications of the acquired dyslexias and agraphias. However, in the last three decades, following the pioneering works of Marshall and Newcombe (1966; 1973) and Beauvois and Dérouesné (1979), a psycholinguistic analysis of the dyslexias and agraphias has been developed, giving rise to numerous studies in English and French. According to the findings of these researchers, there seem to be at least three types of central dyslexias known as "deep dyslexia," "surface dyslexia," and "phonological dyslexia." These syndromes stand for the description of reading difficulties that seem to range from problems of accessing the pronunciation of a word from its graphic representation to problems of accessing the meaning of a word from its written form.

Marshall and Newcombe (1966, 1973) found two patterns of errors, or paralexias among their patients.[2] They observed that there were a group of

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[1] On the other hand, the term "developmental dyslexia" refers to the difficulty of learning to read in spite of adequate intelligence, instruction, and socio-cultural level (Hynd and Cohen, 1987).

[2] By "paralexias" we mean erroneous transformations of the linguistic symbols. This can occur at different levels; for example, a "literal paralexia" refers to the erroneous substitution

patients who tended to make the following types of errors: i) semantic paralexias, that is, they substituted the stimulus word with another related in meaning to it; for example, they would read *cheer* for *laugh*; ii) morphological errors, that is they read the root of a stimulus word correctly, but with a wrong affix; for example, they would read *driving* for *drive*; and iii) visual paralexias, that is, they would substitute a word with another visually similar word, but that otherwise bears no relationship with it; for example, the word *wife* read as *life*. On the other hand, there was another group of patients who, when reading words with irregular spellings, would make mistakes seemingly disregarding the graphemic context of the letters. They would thus tend to substitute the word for a phonologically plausible, but semantically nonexistent form. For example, the word *blind* was read as /blind/. Marshall and Newcombe called the first syndrome "deep dyslexia" and the second, "surface dyslexia". They claimed that the former reading difficulty could be due to failures in the phonological route and, as a consequence of this, the patient would need to resort to the direct or semantic route from print to meaning in order to read. The second syndrome was explained as the opposite pattern, that is, as failure of the semantic route and need to rely solely on the phonological route from print to pronunciation.

Later Beauvois and Dérouesné (1979) described another syndrome that did not correspond to Marshall and Newcombe's patterns. Their patients could read words with regular as well as irregular orthography, although high frequency words were read better than low frequency words, but had great difficulty with unfamiliar words and nonwords[3]. These researchers named this syndrome "phonological dyslexia."

The three syndromes described above have proven to be far more complex than originally thought and they will be described in greater detail in the next chapter. However, their description and conceptualization was extremely fruitful since they have provided hypotheses and models to be contrasted against empirical observations. This has served to postulate new models of reading and writing and to improve existing ones. The observation that there are patients who seem to have difficulties accessing the pronunciation of a written word, but not accessing its meaning (or partial

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of a letter with another; on the other hand, a "lexical paralexia" refers to the erroneous substitution of a word with another; etc. (Lecours, Lhermitte, and Bryan, 1983). A classification of the paralexias as defined for this study will be explained in detail in Chapter 2.

[3] Nonwords are chain of letters that do not belong to the lexicon of a language but do not violate either the syllabic structure or the phonological constraints and have no semantic content.

meaning), and that there are patients who show the opposite pattern, has given rise to the so-called "Dual-route" models of reading and writing. These models are based mostly on studies of English- or French-speaking patients. The orthographic structure of these languages is such that in most cases the pronunciation of a grapheme depends on its context; that is, English and French have "irregular" or "opaque" orthographies. On the other hand, Spanish orthography is quite "regular" or "transparent" in the sense that, with very few exceptions, graphemes are always given the same pronunciation.

Ardila et al. (Ardila, 1991; Ardila, Rosselli, and Pinzón, 1989) argue that lexical reading is not an option for readers of Spanish due to the transparency of its orthography. According to these researchers, reading Spanish always entails the use of phonological decoding:

> "For Spanish speakers, the underlying cognitive operation during reading is to convert graphemes into phonemes...Our point, simply, is that reading English and reading Spanish represent quite different cognitive activities. Consequently, brain representation of written language and models for alexias and agraphias have to be somehow different." (Ardila, Rosselli, and Pinzón, 1989, p.173)

Although we recognize that a language and its orthographic structure play an important role in reading and writing, we believe that instead of being a problem at the cognitive level it is more a problem of the assumptions and methodology in evaluating reading and writing deficits in Spanish speakers. Ellis (1985) states that since writing is a recent invention, from the evolutionary point of view, (and its more generalized use is even more recent) it is quite improbable that in our genetic make up we have specialized structures developed specifically to process either one writing system or another.

To evaluate this hypothesis, we based our research on the model and evaluation protocol for the dyslexias and agraphias for the French language developed by A.R. Lecours as it appears in his book *Langage Écrit: Histoire, Théorie et Maladies* (Molinghem: Ortho, 1996). We chose this model because it is one of the most specified with respect to the sub-processes involved in reading and writing and because it incorporates the possibility of testing for variations in writing systems and orthographic structures in different languages. In order to evaluate systematically the different sub-processes thought to be part of the reading and writing it is convenient to use a model that

describes and organizes such constituents in a coherent manner. Lecours' model explicitly describes the possible sub-processes involved in the lexical and sublexical routes for reading and writing. Based on these postulates, he developed the specific tests for the French language to check the state of each route at different levels in aphasic patients. Following this approach, we developed an evaluation protocol for the dyslexias and dysgraphias in Spanish, paying particular attention to the linguistic characteristics of this language and the levels of representations of its orthographic structure. When they could be applied, we used Lecours' tests translated into Spanish, but in some cases we developed our own tests, taking into consideration the particular characteristics of this language. The adaptation into Spanish is entirely ours. Lecours' model and the evaluation protocol for the diagnosis of the dyslexias and agraphias in Spanish will be described in detail in Chapters 3 and 4, respectively.

Using this evaluation protocol for the dyslexias and dysgraphias in Spanish, we tested a number of patients and we found the same patterns of reading and writing impairments that have been described for other languages. That is, there were some patients who seemed to have difficulties accessing the meaning of words from the printed form (surface dyslexics), there were some patients who seemed to have problems accessing the pronunciation of words, though they showed some comprehension of those same words (deep dyslexics), and there was a group of patients who seemed to have problems particularly with nonwords (phonological dyslexics). From these we selected some of the cases of patients who have completed the evaluation protocol and who showed the clearest patterns of reading and writing impairment, and presented them for publication in specialized journals. These articles are part of the body of this thesis. These will appear as Chapters 5, 6, and 7.

With the comparisons of the reading and writing behavior of these patients, it will become clear that the different and relevant dissociations found point towards the confirmation that the same syndromes reported for other languages exist in Spanish as well with different clinical manifestations in certain cases. If irrespective of orthographic structure, the same dyslexic and dysgraphic syndromes can be observed, then we could say that the cognitive processes underlying reading and writing are not language specific, as claimed by Ardila and colleagues, but rather, they must be "universal." We conclude that Lecours' model is an adequate universal neurolinguistic model of reading and writing and that with the appropriate testing procedures and appropriate

linguistic criteria for the selection of stimuli, the universality of the cognitive processes of reading and writing can be proven.

One of the results of this study was the development of a testing protocol for the sub-types of acquired dyslexias and dysgraphias specifically for the Spanish language in Venezuela. It should be mentioned that there is still a need for the development of more refined tools for the rehabilitation of adult patients who have had the devastating experience of losing their capacity to read and write. Although we are aware that this testing protocol can be improved in more than one way, we hope that it will be helpful in the evaluation and diagnosis of the subtypes of dyslexias and dysgraphias in Spanish, and that this will help in the design of the appropriate therapies for these patients.

Chapter 2:
The acquired dyslexias and dysgraphias.

The strongest evidence in favor of the view that reading and writing are not unitary processes but are the result of a series of subroutines that operate concurrently is the observation that these processes can be affected in selective ways. Usually, in aphasic patients, along with their difficulties in speech, deficits in reading and writing are observed. Moreover, the dyslexias and the dysgraphias can be found in the absence of speech problems, and even independently of one another (Lecours, Lhermitte, and Bryan, 1983; Marshall, 1989; McCarthy and Warrington, 1990). Dejerine, in 1892, was the first to describe a case of relatively pure dyslexia, and Gordiner, in 1899, described a case of relatively pure acquired dysgraphia (Marshall, 1989). The study of the typologies of the dyslexias and dysgraphias as a consequence of brain damage, independent or not of other affections, has shifted to more cognitive analysis. The truth is, as expressed by Marshall (1987), that once the patient has passed through the most critical phase of his/her illness, it is rare to find one with global aphasia; normally, when faced with a word, he/she will show some sort of comprehension, and if asked to read it, he/she will usually produce at least a response somehow related to the stimulus.

The syndromes of surface, deep, and phonological dyslexia mentioned in the Introduction do not exhaust the variety of deficits in reading and writing presented by patients with brain injuries.) In an attempt to classify the reading and writing deficits encountered, McCarthy and Warrington (1990) divide these into two main groups: central and peripheral. Peripheral dyslexias or dysgraphias refer to difficulties in reading and writing that can be traced to perceptual processes, that is, difficulties that affect the capacity of the patient to analyze the visual or sensorial attributes of the written form. On the other hand, central dyslexias and dysgraphias refer to difficulties that affect later stages of the processing, that is, they affect the capacity of the patient to analyze the linguistic properties of the written form in the absence of sensorial impairments.

2.1. Acquired dyslexias.

2.1.1.Peripheral dyslexias:

2.1.1.1. Pure alexia:

This syndrome was described for the first time by Dejerine in 1892, 1895 and 1926 (see Lecours, 1996). It is the total loss of the capacity to read any type of written stimulus. Usually, it is accompanied by right hemianopsia, problems in color naming and color confusion. Patients suffering from pure alexia are capable of copying words, but they do so as if they were copying a drawing, and are not capable of transcribing from capital to small letters and vice-versa. However, sometimes, if a word is spelled out aloud to them, they can name it. In cases where there would be a favorable evolution of the illness, the first skill the patient would recover is letter recognition. Generally, it is associated with brain injuries in the left occipital lobule, the splenium of the Corpus Callosum, and surrounding areas (Lecours, 1996).

2.1.1.2. Spelling dyslexia (letter-by-letter reading):

This disorder, named by Wolpert in 1924, is a type of dyslexia without dysgraphia, wherein a patient reads a word by spelling it letter-by-letter. Sometimes, he/she would recognize the word through his/her previous spelling. The reading of a word without spelling it is not possible. Curiously, spelling dyslexics can sometimes even write coherent paragraphs that they cannot read afterwards (McCarthy and Warrington, 1990). It is believed that this spelling behavior is a compensatory strategy. For obvious reasons, longer words are more difficult to read (Warrington and Shallice, 1980). McCarthy and Warrington (1990) report some studies of patients who have been capable of extracting partial meaning from words presented too fast for allowing spelling processes to come into play. Generally, spelling dyslexia when the patient's pure alexia starts to improve. Spelling dyslexia is usually associated with lesions in the posterior part of the left hemisphere (Kinsbourne and Warrington, 1962).

There are three hypotheses to explain this syndrome. First, it is believed that it is caused by the disconnection of the centers in the right hemisphere that receive the visual input from the centers in the left hemisphere that process linguistic information. Second, it is thought that it reflects a difficulty in integrating visual input in a coherent whole. Third, it is also thought that it might be caused by a failure of a specialized center for the visual processing of written forms. For an evaluation of these three hypotheses see McCarthy and Warrington, 1990.

2.1.1.3. Neglect dyslexia:

In this type of dyslexia the patient correctly and consistently reads either the last part of the word (right neglect) or, much less frequently, the first part of the word (left neglect), separately or in a list, substituting the missing part with a visually similar form. For example, if the target word were *influence*, the patient would read *influenza*. Originally, it was thought that this deficit was due to lateral blindness; however, it has been shown that this is not the case. It has also been proposed that it might be caused by a kind of spatial agnosia; that is, a disorder of recognition and/or comprehension of a stimulus presented in either visual field (McCarthy and Warrington, 1990). In any case, since patients suffering from neglect dyslexia interpret the word based on their erroneous response, this disorder seems to belong to a stage of processing prior to the assignment of meaning to the word.

2.1.1.4. Attentional dyslexia:

In this case the patient can read the letters and some words in isolation, but shows great difficulty reading when more than one letter or word is presented together. It is not very common. In two cases that have been described in the literature, tumors in the posterior side of the left hemisphere going deep into subcortical areas were found. It is believed that these patients must have problems filtering irrelevant information and in focusing their attention (Shallice and Warrington, 1977).

2.1.2. Central Dyslexias.

2.1.2.1. Surface dyslexia:

This syndrome is neither simple nor stable. There is not a precise number of criteria by which one can classify a patient as a surface dyslexic. However, the critical symptom is that the patient will tend to make what is known as a "regularization error," that is, the patient will give to a word containing a grapheme[4] with more than one phonological value, a phonologically plausible, but in this case erroneous, reading of the word in question. For example, the word *bough* read sub-lexically as /bof/ (Patterson,

[4] A grapheme is the written representation of a phoneme. This might correspond to one letter or to a group of letters; e.g. in Spanish, the phoneme /k/ can be written *qu*.

Marshall, and Coltheart, 1985). However, even in patients whose native orthographic systems are more transparent, as in Italian and Spanish, with the appropriate tests, other types of regularization errors have been observed, specifically in the inappropriate assigning of stress to certain type of words (Miceli and Caramazza, 1993; Iribarren, Jarema and Lecours, 1996[5]).

Usually, comprehension depends on the patient's oral production, so that if the word is pronounced incorrectly, the patient will not understand it. In the case of words with regular orthography, generally, it is observed that the patient will repeat aloud the word to himself until he understands it. However, Kay and Patterson (1985) report that there are some patients who seem to understand the meaning of a word even if they have pronounced it incorrectly.

Even if there are variations and different degrees of severity in this syndrome (McCarthy and Warrington, 1990), the main symptoms of surface dyslexia are: i) words written in the most regular form are read better than words with exceptional orthography, ii) the most common error when reading irregularly spelled words is to give them an incorrect, but phonologically plausible reading, that is, the most common reading error is the "regularization error", iii) if there is comprehension, this is dependent on the patient's oral production, iv) there is confusion for understanding the meaning of homophonous words (Masterson, Coltheart, and Meara, 1985), v) semantic paralexias are never or seldom produced, and vi) these patients are quite capable of reading nonwords, although this is dependent on the complexity of the nonwords (Friedman and Hadley, 1992; Masterson, 1985), vi) generally, neither grammatical category, nor level of abstraction, nor length of the word, nor the degree of frequency affects the reading of these patients (Friedman and Hadley, 1992; Kremin, 1980, 1982), although Behrman and Bub (1992) reported a case of a surface dyslexic with a frequency effect when reading.

Usually, the same difficulties observed for reading are observed in writing (Coltheart, Masterson, and Byng, 1983; Kremin, 1985; Shallice and McCarthy, 1985). It is not unusual that surface dyslexics are also fluent aphasics; that is, aphasics characterized by abundant and articulated language empty of semantic content, and deficits in comprehension (Patterson, Marshall, and Coltheart, 1985). Frequently, surface dyslexics present lesions in the left temporal and temporal-parietal areas of the brain (Vanier and Caplan, 1985). This reading behavior seems to suggest that these patients do not have access to

[5] This article is part of this thesis.

the semantic aspects directly from the written form, but only to the phonological decoding or sublexical level of the graphic form.

Surface dyslexia has been interpreted first, as evidence of the existence of a phonological reading route without any interference of the lexical and/or semantic aspects represented in the written form, and second, as the display of a strictly phonological reading due to the malfunctioning of the semantic route for reading (Coltheart, 1981; Marshall and Newcombe, 1973; Morton and Patterson, 1987). The reading behavior of surface dyslexics has been compared with the reading of beginner readers, since it is similar to the way of reading of a person who lacks an orthographic lexicon (Marcel, 1987; Valle Arroyo, 1984).

Nevertheless, the specific stages that operate during sublexical reading are not well understood. One of the issues under discussion is the nature of the unit of perception in sublexical reading. For instance, it would be interesting to know if the unit of perception is a separate grapheme or a group of graphemes, or if it is the syllable or the morpheme (Coltheart, 1980; Glushko, 1979; Henderson, 1982; Lecours, 1996; Shallice, Warrington, and McCarthy, 1983). In addition, the frequency effect of sublexical units has not been investigated. Another issue under investigation is the possibility that surface dyslexia is a problem of either visual or phonological decoding (Kremin, 1985; Lecours, 1996; Shallice and McCarthy, 1985). Perhaps the controversies surrounding this syndrome are due to the variability in the behavior of patients, to the diversity of evaluation procedures for acquired dyslexias in general, as well as to differences in writing systems.

2.1.2.2. Deep dyslexia:

As in the case of surface dyslexia, this is another complex syndrome. Among the symptoms of this syndrome we observe the following: i) the patient has the tendency to make semantic paralexias, that is, to substitute the target word for a synonym or circumlocution, for example, instead of reading *motor*, he would read *car*; ii) he/she would also make morphological errors, for example, in the place of *direction*, he/she would read *direct*; iii) the patient would have more difficulties reading function words than content words, and other grammatical category effects can be observed—nouns and adjectives are read better than verbs and adverbs; iv) visual errors are also observed, that is a target word would substituted by another visually similar word; for example, *sword* can be read as *word*; v) words that refer to concrete, highly imaginable

objects are read better than those referring to abstract concepts; and vi) these patients have great difficulty reading nonwords, and in some cases reading nonwords results in a type of error called lexicalization, that is, the nonword is substituted by a real word that is visually similar to it. Writing difficulties are also observed. However, the central pathognomic symptom of deep dyslexia is the semantic paralexia. If this type of semantic error is present, the other symptoms are likely to be present too (Barry and Richardson, 1988; Coltheart, 1987a; Coltheart, Patterson, and Marshall, 1978).

In a study of the CAT scans of five deep dyslexic patients reported in the literature, Marin (1987) concludes that (a) in every case extensive cortical damage of the left hemisphere was observed (all five patients were right-handed), (b) Broca's area was compromised in three cases (in two other cases Broca's area was probably isolated), (c) supramarginal gyrus involvement was present with complete destruction in four cases, and (d) superior temporal subcortical damage was also extensive, touching white matter of the frontal-central areas and almost always reaching the ventricular frontal horns; other lesioned areas were observed, but were not consistent in all five cases.

Reading in deep dyslexia is not abolished completely; usually, patients who are infrequent readers are successful with concrete high frequency words. Although they often do not read the target word correctly, somehow they demonstrate understanding of the word by using a synonym, a circumlocution, and sometimes gestures. Coltheart (1987b) hypothesizes that the semantic errors of these patients seem to indicate an associative relationship between the stimulus and the response, or a partial activation of the set of distinctive features associated with the stimulus word, and even, perhaps, the evocation of a visual image that later will be named periphrastically. Andreewsky, Deloche, and Kossanyi (1987) compare deep dyslexia with speed-reading, making the assumption that in both cases a kind of "direct" processing from print to meaning is involved by which the reader constructs a representation of the meaning of the text without paying much attention to superficial aspects as phonology and orthography.

Friedman and Perlman (1982), Shallice (1988) and Shallice and Warrington (1987) argue that there are more than one kind of deep dyslexia, since there is the possibility of having trouble either at the input/perceptual level or at the output/response level.

Several explanations have been offered to account for deep dyslexia, however, there is no agreement (Valle Arroyo, 1992). The symptoms shown

by deep dyslexics are of such different linguistic and psycholinguistic natures that a unified explanation is very difficult, and moreover, one wonders why, if these manifestations are so different, they appear in association. On the one hand, the semantic error points towards deficits in the lexical and visual access, but on the other hand, the incapacity to read nonwords suggests serious problems in the sub-lexical or phonological decoding. For Marshall and Newcombe (1973) the semantic system of these patients is intact, and this syndrome is a problem only in the phonological route for reading. Later these same authors (Newcombe and Marshall, 1980) argue that the reading behavior of these patients seems to indicate that the phonological route is impaired and that semantic information is not sufficiently specific to guarantee success in the access of the correct phonological representation of the word. However, Hillis, Rapp, and Caramazza (1999), Morton and Patterson (1987), Nolan and Caramazza (1982), Shallice and Warrington (1987), and Southwood and Chatterjee (1999) do not find this explanation to be satisfactory. In their opinion, the semantic route of these patients must be affected also. Lecours (1996) qualifies deep dyslexia as a multiple functional impairment, and he acknowledges that it is difficult to explain this syndrome.

Coltheart (1987c) and Saffran, Bogyo, Schwartz, and Marin (1987) have considered the possibility that deep dyslexia reflects reading of the right hemisphere due to the damage in the left hemisphere. This is the case more so for semantic and sometimes formal, but not sequential, aspects of reading. However, this hypothesis does not completely explain this syndrome (Coltheart, Patterson, and Marshall, 1987). The truth is, as expressed by Valle Arroyo (1992), that there is no satisfactory explanation for the co-occurrence of the symptoms of deep dyslexia, and even the explanation for the occurrence of the symptoms separately does not seem to be adequate.

2.1.2.3. Phonological dyslexia:

This syndrome has been described as a selective impairment of reading with preservation of comprehension and oral expression, an impairment of phonological reading with preservation of non phonological or semantic reading, and a deficit of reading at phonological coding and not of visual perception or oral reading (Beauvois and Dérouesné, 1979, Beauvois, Dérouesné, and Saillant, 1980; Funnel, 1983; Job and Sartori, 1984; Patterson, 1982). The central symptom is the relative preservation of reading words versus a marked disadvantage in reading non-familiar words and nonwords.

Reading errors are basically visual confusions or derivational errors, for example *killer* read as *killing* —however, sometimes it is difficult to determine when an error is a visual or a morphological one. In contrast with deep dyslexics, phonological dyslexics make fewer errors, and make but a few semantic paralexias. Other effects, such as length effect, word category effect, level of abstraction effect, have little impact on the reading success of these patients.

Sartori, Barry, and Job (1984) reviewed over 16 cases of phonological dyslexia published in specialized journals and found that there is no apparent relationship between the type of aphasia and phonological dyslexia, that there is great variation in the relative success among patients reading words and nonwords, and that the site of brain injury is not consistent among patients. The errors made by these patients when reading words were basically visual and morphological confusions. Nouns were read better than verbs, word abstraction level had no effect on the reading success, and when reading nonwords, there were seldom omissions. Some lexicalizations were produced, but generally a nonword is substituted with another visually similar nonword. Goodall and Phillips (1995) conducted a follow-up study of a phonological dyslexic over seven years and report that this patient was capable of learning to read some nonwords only when they were matched with drawings, otherwise the patient was not capable of reading nonwords.

Phonological dyslexia has been explained as lexical reading due to disruption of the phonological route of reading. However, the phonological route could have failed at different stages. Dérouesné and Beauvois (1979) found a double dissociation[6] in two phonological dyslexic patients—one presented problems with graphemic decoding, but not with phonological decoding, and the other showed the reverse pattern. Dérouesné and Beauvois (1985) and Temple (1985) theorize that phonological reading implies first, the segmentation of the word into graphemes, second, the matching of these graphemes with their corresponding phonological values, and third, the assembling of these segments into syllables and correct prosody. Cuetos, Valle Arroyo, and Suárez (1996) report a case of a Spanish-speaking phonological dyslexic who exhibited problems in tasks dealing with phonological

[6] "Double dissociation" refers to the observation of the opposite behavior of two patients, specifically, when, for example, patient A is capable of performing task X but not task Y, whereas patient B is capable of performing task Y but not task X. This contrast in behavior of two patients is used in neurosciences as evidence of the existence and independence of two cognitive processes (Caplan, 1987)

assembling, but not in tasks dealing with segmentation or the matching of separate letters with their phonological value.

Due to the similarities between phonological dyslexia and deep dyslexia, it has been discussed whether these are two separate reading disorders (Sartori, Barry, and Job, 1984) or two levels of severity of the same syndrome (Gloser, Friedman, 1990).

2.1.2.4. Lexical non semantic dyslexia:

This might be a fourth dyslexic syndrome. It has been studied much less than the other three. It is being compared with "hyperlexia", a kind of developmental dyslexic syndrome (Valle Arroyo, 1992). Healy, Aram, Horowitz, and Kesserl (1982) comment that since 1967 several cases of developmental hyperlexia, children called "idiots savants," had been known. These authors described 12 cases of children who, before the age of 5, developed reading abilities in letter and word recognition superior to their linguistic and cognitive level. There seems to be a genetic factor involved in this condition. Schwartz, Saffran, and Marin (1980) and Sartori, Masterson, and Job (1987) have published the first two probable cases of acquired "lexical non semantic dyslexia." These were patients with progressive senile dementia, with serious oral and reading comprehension deficits, but who could read all kind of words with a high level of success. This observation has prompted the inclusion in dual-route models of reading the possibility of non-semantic but lexical reading, that is, a direct recognition of all kinds of words without understanding. Lecours (1996) incorporates this option in his model (see Chapter 3).

2.2. Acquired dysgraphias.

Acquired dysgraphia refers to writing impairments caused by brain injury, and as in the case of acquired dyslexia, there seem to be different types of dysgraphia. It is true that this skill is less practiced than reading and that it is closely linked with level of education. Another problem in the study of writing deficits of aphasics is that, in addition to their speaking problems, these patients often present right hemiparesia and motor difficulties of the right arm, hence complicating the evaluation.

Writing problems are less well studied than reading problems. Usually, in studies about reading, a few tests of writing are conducted, since it is common that when a patient presents difficulties with reading, his/her writing

will be affected in analogous ways. Although the close relationship that exists between reading and writing cannot be disregarded, the dissociation between these skills has been observed since the end of last century by researchers such as Ogle in 1869, who coined the term "agraphia," Bastian in 1898, and particularly, Exner, in 1881 who postulated the possibility of the existence of a specific center responsible for the motor skills associated with writing, analogous to Broca's area for speech (McCarthy and Warrington, 1990).

Before continuing with the description of the dysgraphias, it is necessary to make the following distinction: the literature about the theme makes reference to problems of "writing" referring to the motor and articulation of movements necessary for the production of the graphemes, and to problems of "spelling" referring to the orthographic knowledge necessary for the sequencing in the production of the written word. It is assumed that dysgraphia can be produced by difficulties related either to peripheral aspects or motor programming, that is writing difficulties per se, or by linguistic or central aspects related to the knowledge of the spelling of the words (Ellis, 1984; McCarthy and Warrington, 1990).

2.2.1. Peripheral dysgraphias.

2.2.1.1. Letter-form-selection dysgraphia:

Zangwill described it for the first time in 1954. Apparently it is a specific form of ideational apraxia. The patient writes in an illegible way with distorted letters, and with omissions, transpositions, and repetitions of strokes; however, sometimes he/she is capable of copying. Papagno (1992) reports the case of a patient who, without being aphasic or suffering any other kind of apraxia, had a severe impediment when writing spontaneously, under dictation, and even copying; however, his oral spelling was preserved. Papagno interprets this writing impairment as an incapacity to use the abstract motor patterns for programming the neuromuscular routines corresponding to the production of each letter. Since the patient is still capable of producing the correct spelling of words in an oral manner, irrespective of class of word, this is an instance of peripheral dysgraphia. A central dysgraphia would affect writing in all modalities.

2.2.1.2. Post-allographic peripheral dysgraphia:

Lambert, Viader, Eustache, and Morin (1994) described the case of a peripheral dysgraphic who made many errors when writing by hand, but not when writing using plastic block letters or when spelling words orally. Although his handwriting was legible, he committed many non phonological errors and other errors completely irrelevant to the correct spelling of the target word to the point that the target word became impossible to recognize. For example, he made errors of insertion, omissions and transpositions of letters. The patient showed a strong word length effect. These researchers qualified this writing behavior as post-allographic peripheral dysgraphia since, apparently, it involves the choosing of the correct motor pattern for the letters of the target word, but not a lack of orthographic knowledge. They hypothesize that there must be an impairment from the allographic code to the motor-graphic store. Based on their analysis of the segmentation of letter strokes and on changes of direction, they found a grapho-motor similarity effect between substituted letters.

2.2.1.3. Spatial dysgraphias:

This type of dysgraphia is manifested in the poor use of the space on the paper, as for example, when the lines fall or rise irregularly, or when the text is gathered all in one corner or particular place on the paper, or when the strokes are repeated again and again over the same spot, etc. Neglect dysgraphia is considered a kind of spatial dysgraphia. In this case the patient has the tendency to consistently ignore one side of the paper or one part of the word. Spatial dysgraphias are usually observed when there are lesions in posterior parietal areas of the right brain hemisphere (Ellis, 1984; McCarthy and Warrington, 1990).

2.2.2. Central dysgraphias.

Central dysgraphias are usually accompanied by spelling deficits analogous to those observed in reading aloud. However, spelling disorders can be observed independently of reading impairments. In a way, the central dysgraphias seem to parallel central dyslexias. Some authors have described what seem to be cases of "surface dysgraphia," "deep dysgraphia," "phonological dysgraphia" and even "lexical non semantic dysgraphia."

2.2.2.1. Surface dysgraphia:

Beauvois and Dérouesné (1981) and Hatfield and Patterson (1983) have described cases of patients who showed the pattern of surface dysgraphia. These patients had great difficulty writing words with irregular orthography, and their spelling mistakes are phonologically acceptable given the graphemes involved. For example, the word *flood* spelled as *flud*, *laugh* as *laf*, and *spade* as *spaid*. These patients show also great confusion when writing homophonous words, even in context (e.g. *sail* for *sale*). Yet they can write nonwords to dictation without much difficulty, but sometimes show the tendency of writing nonwords in the most economical way. Bub and Chertkow (1988) conclude from a review of several cases that although patients show heterogeneity in their writings, there are two observations that emerge from these studies: first, that there is a lack of consistency in the chosen orthographic representation of a phonemic segment; that is, a word can be written in more than one way; and second, that there is a presumable failure of consistently employing the "correct" principles of phoneme-grapheme correspondence rules. From these observations we can conclude that surface dyslexics seem to lack an orthographic visual lexicon and need to resort to a sort of phonological transcription when they spell a word. For words spelled in a regular way, this strategy can provide the expected results; on the other hand, for words spelled irregularly, this will not always succeed.

2.2.2.2. Deep dysgraphia:

The symptoms of this syndrome parallel those described for deep dyslexia, and the hypotheses concerning the possible explanations for the observation of this writing deficit are just as complex. Although, as has been discussed previously, the usual case is that when a patient shows a reading deficit he/she will show a similar disorder when writing, Bub and Kertesz (1982) described the case of a patient who exhibited all the symptoms of a deep dysgraphic, but who can read without problems. This patient made semantic paralexias (e.g. wrote *table* for *chair*), visual errors (e.g. *around* instead of *amount*), spelled concrete nouns better than abstract ones, spelled nouns better than verbs and function words, and primarily, was unable to write nonwords to dictation. Another case of presumably deep dyslexia is one described by Hatfield (1985) of a patient whose handwriting with his left non-preferred hand was clear, but whose spelling performance was poor and presented the same type of errors described for deep dyslexia. Moreover, he would write the words

in a nonlinear order, that is, he would start from the middle, the end or the beginning of the word. Hatfield argues that this patient's non-linear writing is good evidence of a lexical-visual strategy, or at least of a non-phonological strategy.

2.2.2.3. Phonological dysgraphia:

Similar to its reading counterpart, in this syndrome patients have great trouble writing nonwords or nonsense syllables to dictation, but perform better when writing real words, irrespective of orthographical regularity. Sometimes effects of abstractness, grammatical class, and length are observed (Bub and Chertkow, 1988). Shallice (1981) describes a patient whose success in writing nonsense syllables reaches only about 26%, but who can write 90% of real words of various kinds correctly. This patients reads all kinds of words effortlessly.

2.2.2.4. Lexical non-semantic dysgraphia:

Phillips and Goodall (1995) report the case of a patient who can write legitimate words irrespective of orthographic complexity, has great difficulty with nonwords, and has severe comprehension problems. These researchers wonder if this could be a case of "lexical non semantic writing" but argue that this possibility needs further confirmation. Observations of lexical non-semantic writing have been reported (André Roch Lecours, personal communication).

More recently several cases have been published of patients who make certain types of errors that cannot be explained in terms of impairment of lexical or phonological processes, do not present motor impediments, but who, nevertheless, make spelling mistakes of transposition of letters, repetitions and omissions. Particularly in languages like English and Italian, they make errors concerning geminate letters; e.g. *cross* spelled *croos*. In order to explain this phenomenon, researchers such as Caramazza and Miceli (1990), Miceli, Silveri and Caramazza (1985), McClosky, Badecker, Goodman-Schulman and Aliminosa (1994), and Venneri, Cubelli, and Caffarra (1994) postulated the existence of an "Orthographic Buffer" or temporal orthographic memory. In this buffer, once a lexical or phonological representation of a word has been accessed, not only the letters that form the word, but also the graphic structure

of the sequence of the letters that constitute the word are codified. The graphic representation of a word is not a simple sequence of letters but a multi-dimensional structure that codifies separately the letter position, the letter identity, the status of such letter (i.e. consonant/vowel), gemination, syllabification, etc. This multi-dimensional conception of the graphic representation of a word is based on the Autosegmental theory of phonology of Goldsmith (1995) among others. According to this idea, the orthographic misspellings of these patients are explained as the result of the degradation of the graphic representation of the word and difficulties with the mechanisms that could be employed to repair such degraded representation. This is an interesting proposal that has not yet been developed fully, but that promises to be very useful explaining not only spelling disorders of patients with brain damage, but also cases of dysorthography in healthy adults and children who are learning to write.

Chapter 3:
The Lecours (1996) model of reading and writing

3.1. Theoretical basis:

In order to evaluate systematically the sub-processes involved in reading and writing, it is indispensable to have as guide some sort of model which describes such sub-processes and organizes them in a congruous manner. As we have mentioned in the Introduction, we chose to work with Lecours' model because we consider that it fulfills these requirements. This model describes explicitly and in detail the possible procedures required to read and write at the lexical and at the sub-lexical levels. Moreover, it incorporates the orthographic structure of a language as a variable influencing such processes. However, before describing Lecours' model, we must outline the theoretical foundation and methodology on which this model is built.

Based on the identification of the different patterns of dyslexias and dysgraphias, several modular models of reading and writing have been developed[7]. These are generally known as "Dual-route Models" of reading and writing. As examples of these we can mention those of Coltheart, Curtis, Atkins, and Haller (1993), Ellis (1984), Marshall and Newcombe (1973), Morton (1979, 1980), and of course Lecours (1996).

Lecours' model, like other models in cognitive neuroscience, is also a functional model in the sense that it postulates from the observation of certain clinical pathological cases, a set of hypotheses about the normal cognitive functioning of a person when he/she reads or writes. The purpose of a functional model is to represent the cognitive mechanisms that might be involved in the normal functioning of the brain. These models have developed from the observation of selective impairments of behavior as a consequence of brain injuries, and particularly from observations of double dissociations of behaviors between patients. If, for example, one observes that a patient cannot write using a pencil, but when given plastic block letters he/she is able to do it, and that there is another patient who shows the reverse pattern, we have a basis

[7] There is another type of model according to which when one reads a word, a pattern of connections related with all kinds of information relevant to that word is activated. This pattern of activation is the product of the experience of the reader with that word. This type of model is based on the notions of neural connections and computer simulations (Plaut, McClelland, Seidenberg, and Patterson, 1996; Seidenberg and McClelland, 1989). Although the machine succeeds in simulating some aspects of reading in an impressive way, so far the simulation and explanations of the dyslexic syndromes using these parameters are not more adequate than those provided by modular models.

to hypothesize that there must be at least two separate mechanisms for writing: one for the motor programming of handwriting and another one for the visual identification of letters.

We cannot deny that this methodology has been very productive in the cognitive neurosciences since it has give rise to innumerable postulates and models about the functioning of the brain. The question is, up to what point can we make inferences about a healthy brain based on observations of pathological behavior? (Kosslyn and Intriligator, 1992; and Sergent (1988). We can answer affirmatively if we keep in mind that these postulates are also based on the notions of modularity of cognitive processes and the assumption of "transparency," which we will explain below.

The theory of the modularity of cognitive processes was postulated by Fodor (1983). According to this, cognitive processes are not unitary processes but are assembled from specialized distinct "modules" that perform a particular task related to that function, communicate in limited and specific way, and are computationally autonomous. Hence, this theory assumes that each module has access only to the type of information that it serves, it computes this information in a rapid and automatic way, it generates an intermediate representation to which we do not have conscious access, and that this intermediate representation passes to the next module, or to a central cognitive system that, perhaps, operates in a different manner (Garfield, 1989). Marr (1976, in Marshall, 1989) claims that the advantages of a system like this is that a small change in a module will not have dramatic consequences on the whole system but only to the aspects immediately related to its functioning. According to Marshall (1989) the description of normal reading and writing is modular but not in such a strict sense; however, it must be recognized that the basic components of the system are independent mechanisms with a strict interaction between them. If we establish that a dyslexic patient has no access to the correct pronunciation of a word, but gives signs of understanding the meaning of such word, we could say that there must be certain modules responsible for the phonological processing of the word that do not seem to be working properly, and other modules responsible for the semantic encoding of the word which seem to be working somehow.

On the other hand, the "transparency" assumption (Caramazza,1992) postulates that:

> "we must assume that the effects of brain damage on the cognitive system are such that (at least some of the time) they result only in local modifications of the system, leaving

> undamaged other parts. Furthermore, the type of modifications that result from the damage must not lead to the creation of new processing structures. That is, the functioning of the modified system must represent no more than the local modification of the processes available to the normal cognitive system...the relation must be transparent in the sense that the hypothesized modifications of the normal processing system are tractable within the proposed theoretical framework." (p.82)

According to this hypothesis, the observed deficit is a reflection of the type of processing that would form part of the healthy system and that, then, it is possible to "subtract" the pathological behavior from the normal cognitive functioning. Therefore, the behavior of a patient with a localized brain injury can be seen as the result of the subtraction of his/her deficit from normal functioning, and at the same time, this allows us to see an aspect that might form part of a normal cognitive system. Marshall and Newcombe (1973) claim that dyslexic errors can be interpreted in terms of an analysis of normal reading, and that the type of errors show that the structural organization of language skills in the brain is sufficiently strict to put restrictions on the type of deficits possible. In other words, brain injuries do not result in random psychological disturbances.

The assumptions of modularity and transparency have permitted the generation of models of normal reading based on pathological evidence. However, as clarified by Lenneberg, speaking about language capacity of man, in his book *The Biological Foundations of Language* (1967):

> "It is not so much one or the other specific aspect of the brain that must be held responsible for the capacity of language acquisition but the way the many parts of the brain interact. Thus it is mode of function rather than the specific structures that must be regarded as the proper neurological correlate of language" (p.170).

Therefore, in an analogous manner, we can say that the processes of reading and writing are the result of the way in which the many parts of the brain interact and not only of the isolated functioning of a module. It is the pathology that gives us a fractionated view of the process.

3.2. Description of the model:

The complete description of the model and rationale behind it are found in the book by A.R:Lecours (1996) *Langage Écrit: Histoire, Théorie et Maladies* (Molinghem: Ortho). We will describe only those aspects of the model that are directly relevant to this research.

Lecours' model is a functional modular model of reading and writing that postulates a series of hypotheses about the existence of a number of specialized memories, registers, or lexicons, and processes involved in the coding and decoding of the written word. According to Lecours (1996), once a word has been perceived, visually in the case of reading, or heard in the case of writing to dictation, its decoding can proceed either by a lexical route or by a sublexical route, or both in some languages. A lexical decoding requires that the word is perceived in units equal to a word[8], and on the other hand, a sublexical decoding requires the analysis of units smaller than the word. In either case the initial representation, or input, passes through various sub-processes that result in intermediate representations that will undergo other interpretations until a final representation is reached, that is, the reader/writer obtains a determined output.

The model for reading aloud supposes the existence of various memories of different nature and procedures by which the visual information can be interpreted linguistically, and the model for writing to dictation postulates the specialized memories and procedures necessary to interpret linguistic auditory input in grapho-motor information. Although both processes share some modules, they are not mirror images of each other.

3.2.1: Graphic conventions.

In order to understand the graphic representations of the model the following graphic conventions must be identified. Each box stands for a specialized memory, register or lexicons of certain types of representations, and each arrow stands for a process that the different kinds of information will undergo. Each module is relatively independent from the others. "Input" modules contain, at least in part, exteroceptive representations (i.e., information originating outside) and "output" modules contain proprioceptive representations (i.e., information generated internally). Inside the boxes and arrows, we will find the following letters:

[8] Idiomatic expressions are understood as lexical units, in which case decoding units bigger than the word are supposed to be processed in this manner as well.

S (white capital s in a black box) means that this box represents a specialized memory or store.

P (white capital p in a black box) stands for a process or procedure that the representation must undergo before passing to the next store.

P+S (capital p and s in a black box) means that the activity in this module is the result of non-specified procedures over a non-specified type of representation.

+++ (a series of three plus signs) means that the representation in this module must be kept activated or inhibited for a period of time (n milliseconds) to be processed.

3.2.2. The model for reading aloud.

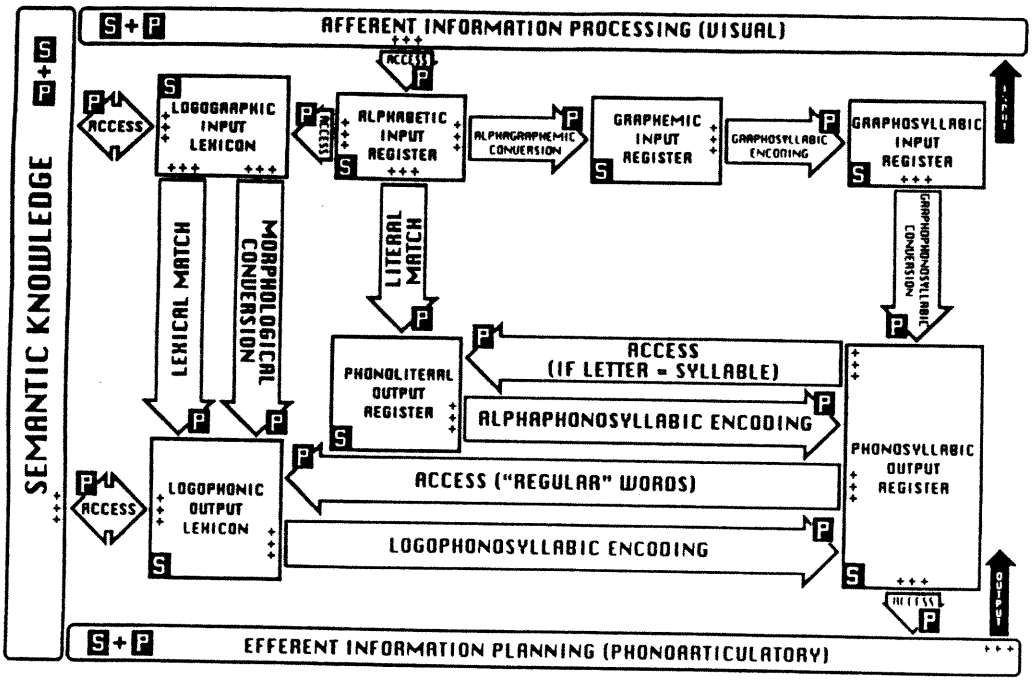

Figure 1. Reading aloud (words, locutions, phonologically legitimate non-words).

Figure 1 (page 24) shows the modules and procedures involved in reading aloud words written in alphabetic writing systems theorized by the Lecours model (1996). Reading a word aloud can proceed by two routes, either a lexical route or a sublexical route. It is probable that the lexical route could be semantic or non-semantic. We will discuss the latter possibility further on.

In any case, in order to read every word, it must be perceived as a visual linguistic sign different from other visual non-linguistic signs. This process of visual discrimination is carried out in the AFFERENT INFORMATION PROCESSING module (see Figure 1) which functions as a kind of filter recognizing certain graphic signs as a possible written word from other visual input. This visual representation will be accessed by the ALPHABETIC INPUT REGISTER (in Figure 1) which contains the abstract representations of letters and where each grapheme will be recognized as a letter in particular, regardless of type or style. That means, for example, that the graphemes 'A' and 'a' can be recognized as allographs of the same letter. From that module on, the visual representation of the word can follow different routes: a lexical route or a sub-lexical route. Under normal circumstances, a skillful reader in languages like English and French reads aloud using both routes according to his familiarity with the orthography of the words, the purpose of his/her reading, etc. However, in Spanish, due to the regularity of its orthographic system, a reader can read aloud using the sublexical route exclusively without comprehension, regardless of whether or not the great majority of words are familiar to him.

To read using the sub-lexical route, once the letter has been recognized, the visual representation of the letter by a process of ALPHAPHONEMIC CONVERSION, passes to the GRAPHEMIC INPUT REGISTER (in Figure 1) that contains the mental representations of the graphemes for the particular language in question. There, for example, the two letters 'Q' and 'U' together, 'QU' will be recognized as one grapheme corresponding to the phoneme /k/. Then by a process of GRAPHOSYLLABIC ENCODING, these representations will proceed to the GRAPHOSYLLABIC INPUT REGISTER (in Figure 1) that contains the abstract representations of all the possible syllables of the language. For example, the graphemes 'QU' and 'E' will be computed as the syllable 'QUE' (/ke/). Through a process of GRAPHOPHONOLSYLLABIC CONVERSION, these syllabic representations will reach the PHONOSYLLABIC OUTPUT REGISTER (in Figure 1, page 24) that contains

the abstract phono-articulatory forms of all the syllables of the language in question. These phono-articulatory representations will be sent to the EFFERENT INFORMATION (Phono-articulatory) module for the programming of the articulatory movements necessary to pronounce the syllable aloud. Reading aloud through this route implies the segmentation and regrouping of segments into representations of different dimensions. This allows for the reading aloud of some words correctly without comprehension. This can also be observed with irregular orthographic systems. However, in order to read aloud with comprehension, a reader must proceed through the lexical route.

In order to read with comprehension, once the letters comprising a word have been identified in the ALPHABETIC INPUT REGISTER, this visual image passes to the LOGOGRAPHIC INPUT LEXICON (in Figure 1, page 24). This specialized memory contains the abstract visual representations of the lexical units known by the reader. These include not only words, but perhaps also morphemes, idiomatic expressions, as well as some bound morphemes. This representation is then matched by a process with the SEMANTIC KNOWLEDGE (**S**) that the reader has for such input. In this manner, the reader has reached the meaning of the word, but since he/she is reading aloud, then this representation is sent to the LOGOPHONIC OUTPUT LEXICON where the lexical units are stored in their phono-kinestetic[9] form. This representation will go through a LOGOPHONOSYLLABIC ENCODING process to the PHONOSYLLABIC OUTPUT REGISTER (in Figure 1, page 24) as in the case of the representations coming from the sub-lexical route, and from there, they will follow the same route as the sublexical representations.

Lecours incorporates in his model the possibility of non-semantic lexical reading based on information received by this author from his colleagues in China and Japan who had observed cases of patients capable of reading logographic characters without comprehension. As we mentioned in Chapter 2, section 2.1.2.4. Visual non semantic dyslexia, cases of patients who seem to read without comprehension has been reported by Schwartz, Saffran, and Marin (1980) and Sartori, Masterson, and Job (1992). In this type of reading then, the visual lexical representation would go directly from the LOGOGRAPHIC INPUT LEXICON to the LOGOPHONIC OUTPUT LEXICON via LEXICAL MATCHING procedure (see Figure 1, page 24),

[9] A phonokinestetic representation permit us to program the articulation of a phoneme or a sequence of phonemes.

without having passed through the SEMANTIC KNOWLEDGE. The theoretical possibility of this type of reading exist, and some possible cases have been reported in clinical observations (A.R. Lecours, personal communication).

In order to spell a word aloud, according to Lecours, a different course is necessary (see Figure 1, p 24). To say each letter aloud, the visual representation in the ALPHABETIC INPUT LEXICON will be matched to the corresponding phono-kinestetic representation of the name of that letter contained in the PHONOLITERAL OUTPUT LEXICON. For example, letter 'P' will be associated with its name /pe/, and the letter 'Y' with its name /wai/. The name of the letter then must be codified phonologically to be reproduced according to the corresponding ALPHAPHONOSYLLABIC programs.

3.2.3. The model for writing under dictation.

In Figure 2 we can see the graphic representation of Lecours' model of the modules and procedures involved in writing under dictation in alphabetic writing systems. In an analogous manner to the process of reading aloud, in writing under dictation there is also the possibility of using either a lexical or a sub-lexical route, and even perhaps the possibility of using a non-semantic lexical route.

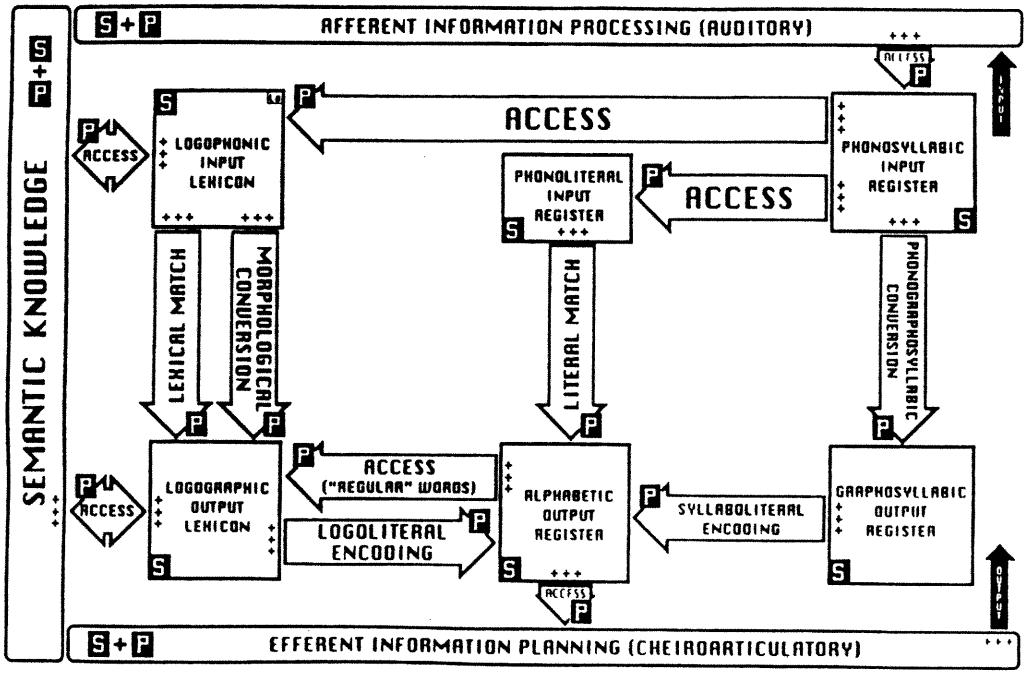

Figure 2. Writing to dictation (words, locutions, phonologically legitimate non-words).

Nevertheless, there is always an AFFERENT INFORMATION PROCESSING (see Figure 2, page 27) by which linguistic auditory information is filtered from among other kinds of auditory information. In the case of sublexical writing, this auditory input passes to the PHONOSYLLABIC INPUT REGISTER which contains the abstract phonological representations of all the syllables of the language in question. The phonological representation of the target syllable, through a process of PHONOGRAPHOSYLLABIC CONVERSION, will reach the GRAPHOSYLLABIC OUTPUT REGISTER (Figure 2). In this register, the abstract graphic representations of the syllables of the language are found. Then through a process of SYLLABOLITERAL ENCODING, these intermediate representations will go to the ALPHABETIC OUTPUT REGISTER. This specialized memory contains the abstract visual representations of the letters that constitute the syllable. The representation of each letter, in the correct order, style, etc., will be converted into its corresponding cheiroarticulatory[10] form in the EFFERENT INFORMATION PLANNING module (Figure 2). This will allow the writer to execute the appropriate manual movements to write the dictated word. This is the route we most likely use when we write a word strictly by its sound, without taking into consideration its orthographic peculiarities. A person using only this route to write will behave like a surface dyslexic; that is, he/she will tend to produce errors that preserve the phonology of the word but not its orthography, and will probably show homophonic confusions.

For lexical writing with comprehension, on the other hand, once the phonosyllabic representation of the word has reached the PHONOSYLLABIC INPUT REGISTER, this will go to the LOGOPHONIC INPUT LEXICON (Figure 2, page 27), which contains the phonologic representations of the lexical units known by the writer. There the representation is recognized as a lexical unit of the language and then passes to the SEMANTIC KNOWLEDGE (S) module to be interpreted semantically. According to the meaning of the word, this representation will be matched with its corresponding abstract lexical-orthographic representation found in the LOGOGRAPHIC OUTPUT LEXICON. Through a LOGOLITERAL ENCODING process, this representation will move to the ALPHABETIC OUTPUT REGISTER and will

[10] A cheiroarticulatory representation permits us to program the movements necessary to write a grapheme or a sequence of graphemes.

continue along the same route described before for the programming of the hand movements necessary to write the word.

This model also incorporates the possibility of writing a word of irregular orthography correctly without comprehension. This would be possible if the logophonic representation of the word goes directly from the LGOPHONIC INPUT LEXICON to the LOGOGRAPHIC UTPUT LEXICON through a LEXICAL MATCHING procedure without passing through **S** (see Figure 2, page 27). So far, there has been a case reported by Phillips and Goodall (1995) (see Chapter 2, section 2.2.2.4) of a patient who seems to write in this manner. However, more studies are necessary.

In order to write a letter under dictation, the phonological representation of the name of the letter in the PHONOSYLLABIC INPUT REGISTER will go to the PHONOLITERAL INPUT REGISTER, that contains the conventionalized names of the letters. From this specialized memory by a LITERAL MATCHING process, the representation will go to the ALPHABETIC OUTPUT REGISTER and later the necessary motor programs of the hand will be activated (see Figure 2, page 27).

As we have already discussed, this model consists in a series of hypotheses that we will use to guide us in the systematic evaluation of our patients' reading and writing. It will enable us to proceed in an orderly and methodical way. According to this model, reading and writing can fail at different levels and for different causes; therefore, it is necessary to examine the different modules in order to better circumscribe the possible causes of the problem. We are aware that the confirmation or rejection of the different hypotheses will depend on the design of the evaluation instrument, and particularly on the selection of the stimuli to be used in each test. This is because one of the strongest assumptions is that the linguistic properties of the word—its grammatical category, level of familiarity, abstractness, length, orthographic regularity, etc.—will determine the way the patient reads and writes, and the possibilities for success in accessing the correct orthographic representation.

Chapter 4:
Protocol for the evaluation of the dyslexias and dysgraphias in Spanish

4.1. The orthographic structure of Spanish and its relevance in the evaluation of the dyslexias and dysgraphias.

4.1.1. Some notes on writing systems.

The manner in which the different writing systems represent the spoken language has been recognized as one of the relevant variables in the learning, processing, and disturbance of reading and writing (Henderson, 1982; Katz and Frost, 1992; Kavanagh and Venzeky, 1980; Lecours, 1996; Perfetti, Zhang, and Berent, 1992; and Tzeng and Hung, 1988). Research on reading and writing disturbances has been carried out mainly in English and French. However, although these languages employ the same alphabetic writing system as Spanish, they use different orthographic systems.

Before continuing, we are going to provide some definitions. According to Coulmas (1990) a "writing system" refers to the system of visual signs that can represent the linguistic units of the language at different levels; for example, the phoneme, syllable, morpheme, lexeme, etc. A "script," on the other hand, is the graphic realization of the writing system; for example, the Latin alphabet. An "orthography" refers to the application of the rules of the script to each language in particular. In this manner, we can speak about a logographic writing system that uses Chinese characters as a script, according to the orthographic rules that apply in the case of the Japanese language or about an alphabetic writing system, using the Latin alphabet according to the orthography of the English language.

A writing system must be differentiated from other systems of visual signs. Chao (1968) defines true writing system as follows:

> "If at any time a usage is established such that a certain visual symbol, however, simple or complicated, is specifically associated with a linguistic form, however simple or complicated, so that a person who knows the usage on seeing the

> symbol will say only that particular linguistic form and not one of its synonyms, then we have a true case of writing." (p.101)

There is an intrinsic relationship between spoken and written language, although we must admit that we do not speak as we write or write as we speak. For a writing system to develop, the spoken language must be analyzed according to some linguistic level. We know that spoken language, between pauses, is a phonetic continuum. The only way in which that stream of sounds can be used to communicate is because it can be analyzed in recurrent units at various levels: recurrent syntactic structures, recurrent morphological units, recurrent syllabic units, recurrent phonological units, etc. Since writing derives from spoken language, it is also possible to analyze it in discrete recurrent units (Pulgram, 1976). Every writing system is based on an implicit or explicit linguistic analysis, that segments language units at different levels. The main difference between writing systems, and even between orthographic systems, is based on the chosen linguistic unit of analysis; that is, what each graphic unit is supposed to represent of the spoken language (Coulmas, 1990; Haas, 1976, 1983). In this manner writing systems can be classified into: a) logographic, where the graphic unit stands basically for a linguistic unit at the level of the morpheme (e.g. Chinese Hanzi), b) syllabic, where the graphic unit stands for a syllable (e.g. Japanese Kana or Korean Han'gul); and c) alphabetic, where the graphic unit stands basically for a phoneme (e.g. the Latin alphabet).

Not all aspects of the spoken language are represented in the orthography. Phonetic variations that can be predicted by a general rule are usually not represented graphically. In English orthography, for example, in pairs of words like "profane-profanity," "compare-comparative," "serene-serenity," since the change in the quality of the subjacent vocalic nucleus of the last syllable before the affixation process can be predicted by a general morphophonological rule, it is not indispensable to indicate in the orthography (Chomsky and Halle, 1986). However, there are some orthographic systems like Korean Han'gul where all phonetic variations are indicated with diacritics (Coulmas, 1990).

The rules that relate the linguistic units to the graphic units are bi-directional: there are rules to read, i.e., to associate the written sign with the spoken unit, and rules to write, i.e., to associate the spoken unit with the written sign (Coulmas, 1990; Haas, 1983). The rules of orthographic correspondence can be "one-to-one" when each written sign coincides with only one linguistic unit and vice versa; "one-to-many" when each written sign corresponds to more than one linguistic unit (heterophony), or when one linguistic unit can be written in more than one way (homophony); and also they can be "many-to-many" when a written sign stands for more than one linguistic unit, and a linguistic unit can be written in more than one way.

Orthographies with basically a "one-to-one" correspondence, or very close to that situation, are called "superficial" or "regular" orthographies. Orthographies with multiple correspondence patterns, or "many-to-many," are called "deep" or "irregular" orthographies (Lukatela and Turvey, 1980; Katz and Feldman, 1983). Spanish obeys basically the "superficial" or "regular" pattern in reading. In writing however, there are a few exceptions to this unidirectional correspondence.

The orthographic system of a language may be responsible for somewhat dramatic dyslexic syndromes. In Japanese, for example, where a syllabary is used along with a logographic writing system, reading dissociations between these two writing systems have been observed in the same patient (Paradis, Hagiwara, and Hildebrandt, 1985; Sasanuma, 1987). Although the Spanish orthographic system is very regular, the same dyslexic and dysgraphic disorders described for other orthographies can be observed though in a more subtle manner.

4.1.2. Written Spanish.

Spanish, like English and French, uses the Latin alphabet. In this alphabet, consonants as well as vowels are represented, and phonetic variations are not indicated. Nevertheless, Spanish orthographic rules differ from those of English or French. Spanish orthography is more "superficial" or "regular." Yet some "irregularities" can be found in the Spanish orthographic system.

Spanish orthography is based on the pronunciation, the etymology, and usage of words (Chacón, 1986). The use of the etymology as a principle to determine the spelling of a word allows for some degree of irregularity at the written level. From time to time reforms have been proposed. On the one hand, there are those who advocate in favor of a completely phonological principle to determine spelling; and on the other hand, there are those who favor the etymological principle (Alonso, 1982). A completely phonological system would be rather inconvenient for the representation of dialectical variations in pronunciation, and moreover, the advantage of using visual similarities to determine etymological relationships between words would be lost (e.g., *bien* "good," *bienvenido* "welcome," *bienaventurado* "blessed," etc.). However, with a completely etymological system, the advantage of using a reduced number of graphemes would be lost. Nowadays there is a compromise between these two positions.

The letters employed in contemporary Spanish and their names are found in Table 1. From these, letters K and W are used basically only to write words of foreign origin that have not been hispanicized. Without these two letters, the Spanish alphabet has 28 letters. The rules to read Spanish are unidirectional; that is, each grapheme is read in only one way. However, there are three exceptions:

1) The letter 'X' can be read /s/ as in the word *xenofobia*, /gs/ as in *examen*, /ks/ as in *tórax*, and /h/ as in *méxico*.

2) The letter 'Y' takes a vocalic value as a conjunction, but a consonantal value in any other word.

3) The letter 'R' at the beginning of a word or before 'N' must be read as if it were 'RR.'

On the other hand, writing rules are not unidirectional (see Table 2, page 37). Nevertheless, as compared to other orthographies, Spanish is quite regular. The irregularities are the following:

1) The bilabial stop consonant /b/, that in Spanish between vowels becomes fricative, can be written with the graphemes 'B' or 'V'. The

pronunciation of the grapheme V as a labiodental is considered as foreign accent or affectation (Chacón, 1986).

2) The letter H is not pronounced; it is mute. Nowadays its aspiration value has been lost. It is a vestige of a former aspiration. H is also kept for etymological reasons. Beginning in the 18th century, words that were originally written with 'F' in Latin were transcribed into Spanish using 'H'; e.g. *hijo* from '*filio*', *hacer* from '*facer*' (Alonso, 1982).

Capital	Small	Name
A	a	/a/
B	b	/be/
C	c	/se/
Ch	ch	/(če/
D	d	/de/
E	e	/e/
F	f	/efe/
G	g	/he/
H	h	/ače/
I	i	/i/
J	j	/hota/
K	k	/ka/
L	l	/ele/
LL	ll	/eĵe/
M	m	/eme/
N	n	/ene/
Ñ	ñ	/enye/
O	o	/o/
P	p	/pe/
Q	q	/ku/
R	r	/ere/
RR	rr	/eře/
S	s	/ese/
T	t	/te/
U	u	/u/
V	v	/be/
W	w	/doble be/
X	x	/ekis/
Y	y	/i griega/
Z	z	/seta/

Table 1: Letters and their names in the Spanish alphabet as used in Venezuela

3) In certain contexts, the letters 'G' and 'J' are read as /h/. This ambiguity started in the 13th century, when the sounds of G followed by E or I, i.e. GE and Gi, were confused with JE and JI that have the same sound. Thus /he/ can be written either GE or JE, and /hi/ can be spelled either Gi or JI. To this it must be added that the grapheme X can also take the phonemic value of /h/ as in *méxico, quixote, Ximena, xeréz*, etc. This probably originated from dialectical differences, and because the letter 'J' was used to substitute the letter 'X' in words of Latin origin, e.g. *dije* from *dixi*. For example. In 1640, *gente, jente*, and *xente* (meaning "people") were written interchangeably.

4) In Venezuela, and mostly in the North of Latin America, the letters 'LL' and 'Y' (with its consonantal value) are both pronounced /j/. Thus words like *rayo* and *rallo* are pronounced exactly in the same manner although they mean different things. This is another source of homophony.

5) Another possible source of orthographic confusion in the Spanish of Latin America is that the phoneme /s/ can be written with 'S', 'Z', and before 'E' and 'I' it can be written with 'C'. And as we mentioned before, in some instances it can be written with 'X' (e.g., *xilófono*).

6) The phoneme /r̃/ inside a word is written with the letter RR ("double R"); however, at the beginning of a word or before the nasal phoneme /n/ it is written with only one R.

With respect to visual complexity, Spanish orthography contains various graphemes that are written with double letters, for example, LL = /j/, CH = /c/, Qu = /k/, Gu = /g/ (before 'e' and 'i'), and rr = /r̃/.

Sampson (1984) mentions that among users of the Latin alphabet, Spanish is one of the languages that marks the place of the accent scrupulously. In Spanish, the unmarked tonic or prosodic stress falls in the penultimate syllable that ends in a vowel, a nasal, or in 's'; otherwise, it falls in the last syllable (Harris, 1983). Whenever a word does not follow this pattern of prosodic accent, that is, it has a marked stress pattern, it must be marked with a diacritic over the vowel nucleus of the stressed syllable. This information must be provided in the lexicon.

Phoneme	Grapheme
/b/	B, b or V, v
/s/	S, s; Z, z; or C, c (before e or i)
/c/	Ch, ch
/d/	D, d
/f/	F, f
/g/	G, g (before a, o, u); or Gu, gu (before e,i)
/i/	I, i; or Y, y (as a conjunction, and in diphthongs)
/h/	J, j; G, g before e and i); or X, x
/k/	Qu, qu (before e, i); or C, c (before a, o, u)
/l/	L, l
/j/	LL, ll; or Y, y (with consonantal value)
/m/	M, m
/n/	N, n
/ɲ /	Ñ, ñ
/p/	P, p
/r/	R, r
/ř/	rr
/t/	T, t
/ks/	X, x
/a/	A, a
/e/	E, e
/i/	I, i, or Y, y (as conjunction)
/o/	O, o
/u/	U, u

Table 2: Phoneme-grapheme correspondence in the Latin America Spanish

However, the diacritic accent has another orthographic use as well. Sometimes it is used to differentiate homophonous function words; for example, 'él'(third person singular) and 'el' (singular masculine article), 'sí' (affirmative adverb) and 'si' (conditional conjunction), etc. It is also used to indicate that two consecutive vowels, specifically, a mid or low vowel (A, E, or O) and a high vowel (I, or U), do not form a diphthong, but belong to separate syllables (a hiatus). In that case a diacritic accent is placed over the high vowel, e.g., *baúl, día*.

By knowing these few exceptions and these few orthographic rules, it is possible to read Spanish correctly without understanding what one reads. However, writing to dictation without understanding the meaning of the word or its orthography is more difficult. Nevertheless, this task is not as difficult as it is in English or French.

These few "irregularities" in Spanish orthography help readers, even in unconscious ways, to detect common morphemes or other types of etymological relationship between words. From this point of view, we can say that although the basic principle of Spanish orthography is phonological transcription, there are also etymological and visual aspects that we could qualify as logographic. The truth is that there is no such a thing as a "pure" orthographic system (Caravolas, 1993). There is nothing in the Spanish orthography that can prevent a skillful reader from processing the written words to a level deeper than the grapheme-phoneme correspondence. Neither the morphology nor the semantic aspects of the written word are concealed by the orthography. The linguistic description of the smallest graphemic unit of a writing system is one thing; its potential to represent a word at another level is another thing. The orthographic system of a language must not deprive a reader of cognitive options. As Marshall (1976) says, we must not confuse the formal nature of an alphabet with the psychological processing of such an alphabet.

4.2. General description of the protocol for the evaluation of the dyslexias and dysgraphias in Spanish.

4.2.1. Preliminary considerations:

The most adequate method for collecting information in neuropsychological research is the case study. It is very important to have detailed and in depth knowledge of each patient's behavior in order to understand his/her problem. We must not forget that we are dealing with human beings that come to us for help. It is expected that if data about each patient were collected in an objective, complete, and systematic way, eventually, with information from all those case studies, statistical projections would be possible. However, considering the great variability found between patients, for the time being, the most adequate method of studying neuropsychological cases is qualitative analysis.

The purpose of each test in this protocol is to evaluate the state of each module and process postulated in Lecours' model, but for Spanish-speaking patients. Whenever possible, we have adapted some of Lecours' tests to Spanish, but we have also developed our own tests when we considered that the linguistic and orthographic nature of the Spanish language made it impossible to use Lecours' tests. In addition, we used other tests that do not belong to Lecours' protocol, but that were suggested by information found during our review of the literature.

Each test will be introduced with its description, rationale, instructions, and lists of stimuli, including controls. In order to make the appropriate analyses, it is essential to write down not only the number of correct responses per test, but also the quality of the patient's response. As we have seen, the kind of errors a patient makes is quite revealing of the strategy that he/she is using to read the stimulus.

With respect to the performance of each patient in each test, the usual practice is to report the number and percentage of correct responses. The obtention of a score enables us to make comparisons between tests, between patients, and even to observe the progress of a patient by comparing the scores

on the same test taken at different times. Numerical results allow for the observation of difference in performance not only between tests, but may also reveal double dissociations in the reading and writing behavior between patients. In order to determine if the observed difference between scores is significant, the appropriate statistical test is the Chi-square test.

4.2.1.1. Error classification.

The quality of the patient's response is of crucial importance. With respect to the categorization of patient's errors, there is no standard nomenclature, but there is relative agreement with respect to the type of errors found. We will use a combination of the nomenclature proposed by Lecours, et al. (1983), Marshall and Newcombe (1966, 1973), and Coltheart, Patterson, and Marshall (1987). As we have mentioned before, the term paralexia is used to refer to the transformations or deviations that a stimulus word undergoes in the patient's response. Errors and paralexias can be classified in the following way:

4.2.1.1.1. Phonemic paralexia:

It is when in the response of the patient we observe the substitution, omission, addition or displacement of a phoneme from the target word (Lecours et al., 1983); for example, *fish -> frish*, or *belleza -> melleza*.

4.2.1.1.2. Lexical/visual paralexia:

Also called "formal verbal paraphasia" by Lecours et al., (1983). This is the substitution of the target word by another visually similar word, but one that has no semantic relationship to it; for example, *musical ->mundial*, *libro-> liebre*, etc.

4.2.1.1.3. Semantic paralexia:

Also called "semantic verbal paraphasia" (Lecours et al. 1983), is when the target word is substituted by another word related in meaning to it; for example, *ancient -> historic*, *child ->girl*, etc.

4.2.1.1.4. Circumlocution:

This is a type of semantic paralexia, but the patient instead of answering with one word only, gives a phrase or a series of words that shows comprehension of the stimuli; for example, *canal* -> *"not river...small river,"* *representación* -> *"otro por mí"* (Trad.= "representation" -> "another one in my place").

4.2.1.1.5. Lexical paralexia:

Lecours et al. (1983) use "verbal paraphasia". This is the substitution of the stimulus word for another that has no relationship to it; that is, it has neither semantic, phonological, nor orthographical similarity with it; for example, *tree* -> *scissors*.

4.2.1.1.6. Morphological paralexia:

This is observed when the patient substitutes an affix from the target word. Usually, the patient substitutes a longer affix for a shorter or simpler one (Patterson, 1987); for example, *corriendo* -> *correr*. However, sometimes the opposite is observed as well; e.g., *pereza* -> *peresozo*.

4.2.1.1.7. Visual then semantic paralexia:

From the patient's response, it can be presumed that first, there was a visual confusion, and then from this, there was a semantic substitution; e.g. *sympathy* -> *orchestra* (from symphony?); *earl* -> *deaf* (from ear?) (Marshall and Newcombe, 1973; Barry and Richardson, 1988).

4.2.1.1.8. Neologism:

This occurs when the target word is substituted by another form that is not recognized as a word. That is a string of nonsensical sounds; e.g. *siguiendo* -> *quetables* (trad. "following" -> ?) . Lecours et al (1983) describe another type of neologism in which the patient produces a form that does not exist in the language, but that can be somehow recognized as a possible word; e.g.

italcer instead of *italian*? They mentioned that this type of error is very rare. In this work, we consider only those completely nonsensical productions to be neologisms.

4.2.1.1.9. Omissions:

When a patient does not give an answer or when he/she answers "I don't know," "I do not understand," "I cannot," etc., we consider that there has been an omission.

4.2.1.1.10. Perseverance:

This is the use of a preferred word (Lecours et al, 1983). It is observed when the patient insists on using of a word, or a group of words, in particular, and uses then indiscriminately, in any situation. There is also phonological perseverance, or the indiscriminate, repetitive, and insistent use of a particular phoneme or group of phonemes.

4.2.1.1.11. Lexicalization:

This can occur only when reading nonwords. This consists of the complete or partial substitution of the target nonword by a real word that resembles it somehow; e.g. *imbaf -> infant*, *expram -> explain*[11].

4.2.1.1.12. Regularization:

This occurs when reading "irregular" words. It consists in assigning to the target word a phonologically plausible reading for the graphic representation, but an incorrect reading for the word in question. This kind of reading is observed, for obvious reasons, more often in languages whose orthographic system is more irregular; e.g. *blood* -> /blud/, *key* -> /kei/, etc.

We observed the analogous errors in writing, but we refer to them as "paragraphias" since they involve the graphic performance of the patient. Because in Spanish there is more irregularity in writing than in reading, it is

[11] Examples taken from Frankel Tal and Siegel (1996).

expected that regularization errors are more common in writing than in reading. These would consist in the substitution of one grapheme for another (e.g. B->V), the omission or addition of the letter "H," and even the misplacement or omission of the graphic accent mark.

Not all errors are easy to classify. Sometimes it can be very difficult to decide whether a particular error is a visual confusion or a semantic confusion (e.g. *torture -> torment*). In cases of ambiguity, an independent judge can be consulted, or these errors can be reclassified according to the typical behavior of the patient. However, it is always advisable to create a separate list containing all ambiguous errors and toanalyze the type of ambiguity before making any decision.

Another difficulty present in the analysis of errors is that some patients exhibit what is known as an approximation behavior and/or of self-correction (e.g. *pero -> "Perro, no, perro, no ,con una sola ere"* (In Spanish "but" is said "pero" and dog is said "perro"). The researcher must decide which answer to take; however, in every case, he/she must document what response was taken.

4.2.2. Medical and physical evaluation of the patient.

In order to facilitate the collection of information about the history of each patient, a form was developed (see Appendix 1). In addition to the personal information (name, age, sex, address, etc.), it is important to know about other aspects of the patient's life such as handedness[12] and history of handedness in the family, occupation, education level, reading and writing habits, and if there were learning difficulties prior to the brain insult. In Latin America, level of education tends to be low and that must be taken into consideration in the analysis of the tests. Ardila, Rosselli, and Puente (1994) have determined for the Colombian population, which has characteristics comparable to that of Venezuela, that age and level of education are variables affecting the performance of patients on psychological tests.

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[12] It is well known that handedness is related with brain lateralization. To determine handedness, it is recommended to use the Edinburgh inventory for the assessment of handedness (Oldfield, 1971).

The medical history and condition of the patient is very important to know. All the events that brought the patient to the medical examination, with dates and relevant details, must be registered including if he/she lost consciousness, or if he/she was hospitalized, for how long, the etiology of the illness, and particularly, the results of all medical examinations performed, the medical diagnoses, etc. Any other medical condition is important to know, for example, if the patient suffers from diabetes, high blood pressure, or has any addiction (to alcohol, smoking, etc.). Information about the site of the brain lesion and its cause is of crucial importance.

In addition, the results of the neurological examination must be reported. We want to know that the observed reading and writing deficits are not caused by circumstances that can be explained in terms of physical or sensorial impairment; for instance, a patient who has lost his/her hearing will necessarily show comprehension problems. Therefore, information about vision (visual acuity and visual fields), hearing, motor functions, etc. is necessary. The presence of the different agnosias and apraxias must be evaluated. Ardila, Rosselli, and Puente (1994) have developed several tests to evaluate these conditions in Spanish speaking patients.

4.2.3. Language evaluation of the patient.

Usually dyslexic and aphasic patients are also aphasic. There are several standard tests for aphasia adapted to Spanish; for example, see Ardila, Rosselli, and Puente (1994), or the adaptation to Spanish by García Albea, Sánchez Bernardos, and del Viso Pabón of the Boston test for the assessment of aphasia (Goodglass and Kaplan, 1983). For the Boston test there are normal data for the Colombian population conducted by Rosselli, Ardila, Flores, and Castro (1990). As we have mentioned already, the Colombian population is very similar to the Venezuelan one. Nevertheless, we are aware that normalization data is needed specifically for our population.

In addition to this, we developed our own tests to explore patient's repetition capabilities (see Appendix 2), and we adapted to Spanish Luria's

Curve of Verbal Learning (Luria, 1966, 1976) (see Appendix 3). Also based on Ardila et al. (1994), we developed a short test of grammar knowledge adapted to the language of our population (see Appendix 4).

4.2.4. Reading evaluation.

4.2.4.1. Test N° 1: Naming of letters (L6)[13]:

The name of a letter is a different type of knowledge from that of its sound (Caravolas, 1993) and perhaps it is closer to the knowledge of other entities. The names of letters are the object of a particular kind of learning (Lecours, 1996). In order to name a letter it is necessary first to recognize it visually and then to access its name. When we ask a patient to name a letter we are checking his/her capacity to recognize it and to search in memory for the name of such letter. In Lecours' model (Figure 1, page 24) this corresponds to the sequence ...ALPHABETIC INPUT REGISTER -> LEXICAL MATCH -> PHONOLITERAL OUTPUT REGSTER -> ALPHAPHONOSYLLABIC ENCODING...

For the tests we selected 16 letters, some vowels and some consonants, whose names correspond either to one syllable (e.g. P = /pe/), disyllabic (e.g. Z = /seta/), and others with more complex names (e.g. Y = /i . grie.ga/). There are also letters with double characters (e.g. CH). We tried to include letters with different degrees of frequency based on our intuition, since there is no statistical study of this kind.

Letters are written in capitals, one per card. They must be presented in a random order to avoid any automatic response based on alphabetic order. Patients are asked to say the names of the following letters.

Stimuli (n = 16):

M	Y	F	B
A	T	C	Ñ

[13] The code in parentheses corresponds to the equivalent test in Lecours (1996); however, the selection of stimuli is our own. When there is no code, this means that either we designed the test or that it is a commonly accepted experimental paradigm.

P	E	S	U
Z	X	R	CH

4.2.4.2. Test N° 2: Discrimination of allographs (L9):

A letter can be written in different styles and there is not always graphic similarity between the graphic representation and the letter in question. To recognize a letter in its different graphic representations is basically a visual task. The main purpose of this task is to check the state of the sequence from the VISUAL AFFERENT INFORMATION PROCESSING module to the ALPHABETIC INPUT REGISTER (Figure 1, page 24).

The task consists in asking the patient to select by pointing to a letter that does not belong to a series of four letters. An oral response is not recommended because this would involve other processes as well that are irrelevant to the visual recognition task itself.

Position of correct response within the series has been controlled. There are a total of 12 series of letters. Six series were constructed based on visual similarity and six based on phonological similarity. In addition, at the beginning there are three series for training. Each series is written in a card and shown to the patient one by one, avoiding alphabetic order.

Stimuli (n = 12 series)

i)	f	F	E	F
ii)	I	Y	i	i
iii)	s	Z	S	S
1)	A	a	e	a
2)	B	b	d	b
3)	X	S	x	x
4)	P	D	P	p
5)	V	W	v	v

6)	J	j	g	j
7)	D	d	t	d
8)	g	q	G	g
9)	b	b	v	b
10)	L	t	T	t
11)	c	c	k	C
12)	v	v	r	V

4.2.4.3. Test N° 3: Reading aloud regular words (L16, L17, L18, and L19)[14]

The linguistic properties of written words can affect the reading of certain types of dyslexics, particularly of deep dyslexics and sometimes phonological dyslexics. In other words, the reading of dyslexics can be susceptible to the characteristics of the written word (Barry and Richardson, 1988; Beauvois and Dérouesné, 1979; Coltheart, Patterson, and Marshall, 1987; Kay and Patterson, 1985; Kremin, 1982, 1985; Marshall and Newcombe, 1963, 1973; McCusker, Hilliger, and Bias, 1981). The effect of the linguistic characteristics of the word on the patient's reading is taken as evidence of the intervention of a lexical-semantic process in the decoding of the word; that is, the use of the sequence ...ALPHABETIC INPUT REGISTER -> LOGOGRAPHIC INPUT LEXICON -> SEMANTIC KNOWLEDGE -> LOGOPHONIC OUTPUT LEXICON ... (Figure 1, page 24). On the other hand, the absence of such effects, is taken as evidence of the use of a sub-lexical route of reading; that is, reading based on the conversion of graphemes into phonemes without any lexical mediation, sequence ...ALPHABETIC INPUT REGISTER -> ALPHAPHONEMIC CONVERSION -> GRAPHEMIC INPUT REGISTER ->

GRAPHOSYLLABIC ENCODING -> GRAPHOPHONOSYLLABIC ENCODING -> PHONOSYLLABIC OUTPUT REGISTER ..., in Figure 1, page 24).

In Lecours' evaluation protocol, there is a particular test for controlling for the frequency effect in the reading of words (L17). However, we have decided to control for the frequency effect of words whenever possible throughout the whole evaluation. Even if one talks of "frequency," based on statistical studies of the words used in a language, it is actually the knowledge and degree of familiarity of the word for each person that affects his/her reading or recognition of each word. However, this is almost impossible to control, since what might be very familiar for one person might not be for another. It would be necessary to study of each patient's vocabulary prior to brain insult and this is certainly not possible. For this reason the best one can do is to use the tables of statistical analysis of word usage in a language to get an approximate idea of the degree of familiarity of words to readers. In this study we have used the Frequency Dictionary of Spanish Words by Juilland and Chang Rodríguez (1964), which contains the frequency index of 20,000 Spanish words taken from plays, essays, novels, journals, and technical reports. We took particular care to exclude those words judged by three independent judges to be unfamiliar for the Venezuelan population. The criteria we used to determine the frequency index of a word was that in the dictionary of Juilland and Chang Rodríguez, 50% of the words have an index of frequency above 17 and these are the words found 94.6% of the time in the texts studied. The rest of the words have an index of frequency below 17 and make up 5.4% of words found in the same samples. Therefore, we considered that words with an index of frequency above 18 were high frequency words, and those with an index below 16 were considered as low frequency words. The index of frequency of each word will appear in parentheses after each word.

In this test, the patient is asked to read aloud the word presented to him/her in writing on a card. We will present first the list of items selected and the rationale for their selection; for example, the lists of nouns, verbs, short and

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[14] This test is a combination of several of Lecours' tests (L16, L17, L18, and L19), but we have

long words, etc. The lists of words that this tests is composed of must be mixed and presented at random, one at time to the patient.

Lists of stimuli:

Nouns: The list of nouns was selected controlling not only for the frequency index of each word, but also for its level of concretion. This is different from Lecours' protocol because he developed separate tests for each category, L17 to control for frequency and L19 to control for level of abstractness. Therefore, in our tests we have 12 high-frequency concrete nouns, 12 high-frequency abstract nouns, 12 low-frequency concrete nouns and 12 low-frequency abstract nouns, for a total of 48 nouns. We tried to control also for the length of the nouns in such way that in each category there are about the same number of words with 2, 3, and 4 syllables.

Stimuli (n = 48):

	HIGH FREQUENCY	LOW FREQUENCY
CONCRETE	1. *ventana* (73)	13. *archivo* (7)
	2. *carta* (103)	14. *almohada* (5)
	3. *cabeza* (142)	15. *astro* (7)
	4. *agua* (156)	16. *ladrillo* (9)
	5. *mano* (297)	17. *folleto* (5)
	6. *libro* (302)	18. *globo* (7)
	7. *ciudad* (318)	19. *ojal* (5)
	8. *escuela* (100)	20. *martillo* (9)
	9. *habitación* (56)	21. *pescado* (8)
	10. *montaña* (51)	22. *rodilla* (10)
	11. *espejo* (48)	23. *aguja* (11)
	12. *jardín* (61)	24. *garra* (8)
ABSTRACT	25. *tiempo* (504)	37. *modestia* (10)

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added other kinds of stimuli and kept the controls in a different manner.

26. *honor* (74)
27. *justicia* (64)
28. *vida* (748)
29. *realidad* (193)
30. *acción* (125)
31. *causa* (118)
32. *confianza* (36)
33. *necesidad* (77)
34. *recuerdo* (60)
35. *concepto* (86)
36. *deseo* (72)
38. *abuso* (9)
39. *casualidad* (11)
40. *coraje* (7)
41. *escasez* (6)
42. *hazaña* (10)
43. *optimismo* (10)
44. *pereza* (8)
45. *reclamo* (8)
46. *venganza* (6)
47. *reposo* (16)
48. *consuelo* (14)

Adjectives: In this list of stimuli 12 high frequency and 12 low frequency adjectives were selected. We tried to control for length of word as well as visual complexity.

Stimuli (n = 24)

HIGH FREQUENCY

1. *conocido* (91)
2. *popular* (73)
3. *contemporáneo* (38)
4. *general* (162)
5. *nuevo* (131)
6. *bueno* (472)
7. *especial* (74)
8. *hermoso* (74)
9. *fácil* (61)
10. *universal* (42)
11. *noble* (42)
12. *grande* (795)

LOW FREQUENCY

13. *cohibido* (7)
14. *pendiente* (7)
15. *respetable* (5)
16. *doméstico* (9)
17. *cínico* (8)
18. *abrumador* (7)
19. *maduro* (5)
20. *furioso* (7)
21. *fértil* (7)
22. *parcial* (11)
23. *leve* (12)
24. *crudo* (6)

Adverbs: In this list of stimuli 12 high frequency adverbs and 12 low frequency adverbs were selected. We tried to control for length of word as well as visual complexity as in the list of adjectives.

Stimuli (n = 24)

HIGH FREQUENCY	LOW FREQUENCY
1. *antes* (336)	13. *cuan* (7)
2. *tampoco* (112)	14. *viceversa* (7)
3. *todavía* (162)	15. *afuera* (9)
4. *dentro* (181)	16. *enfrente* (9)
5. *pronto* (142)	17. *despacio* (11)
6. *mucho* (123)	18. *antemano* (7)
7. *tanto* (148)	19. *entretanto* (14)
8. *durante* (193)	20. *enseguida* (14)
9. *encima* (65)	21. *mediante* (16)
10. *quizás* (115)	22. *adentro* (5)
11. *bastante* (38)	23. *temprano* (12)
12. *asimismo* (62)	24. *basta* (15)

Function words (L4): Function words are those words belonging to the closed class; that is, those words that have basically a syntactic function in the sentence and that usually are low in semantic content. However, they are not completely without semantic content, since they contain notions such as number, gender, temporal or spatial meaning, possession, etc. (Morton and Patterson, 1987). They are called closed class words because it is not possible to create new function words, contrary to the case of open class words such as nouns and verbs, for instance. The reading of this kind of word is particularly problematic to deep dyslexics and sometimes to phonological dyslexics. They tend to substitute one function word for another (Marshall and Newcombe, 1987).

We have included as function words prepositions, pronouns, articles, conjunctions, and some adverbs of high frequency and low semantic content.

Due to their syntactic use, they are words with the highest degree of frequency, therefore, in this list of stimuli there are no low frequency words.

Stimuli (n = 20):

1. *ni* (603)
2. *con* (4.667)
3. *de* (35.144)
4. *pues* (636)
5. *hasta* (613)
6. *sino* (431)
7. *otro* (220)
8. *pero* (1.792)
9. *entonces* (262)
10. *siempre* (558)
11. *también* (633)
12. *porque* (831)
13. *mismo* (97)
14. *durante* (193)
15. *usted* (1.574)
16. *dónde* (508)
17. *desde* (476)
18. *ella* (3.043)
19. *según* (166)
20. *tan* (640)

Verbs: This test corresponds more or less to Lecours' test L5 in which the reading of infinitive verbs is compared with the reading of conjugated verbs. We changed the approach because we consider that an infinitive form of a verb can be frequent or infrequent and that might affect the results of the test. In our list of verbs we took into consideration the frequency of the root of the verb and that of its inflection as well. In Spanish, as in French, verb forms are very rich, and it might be that a particular form of a verb is more common than the others in some texts. We excluded auxiliary verbs because they tend to be too irregular and are mostly high frequency verbs.

We selected 40 verbs from Juilland and Chang Rodríguez (1964) in the following manner: 10 verbs with high frequency roots in a high frequency conjugated form, 10 verbs with high frequency roots in a low frequency conjugated form, 10 verbs with low frequency roots in a high frequency conjugated form, and 10 verbs with low frequency roots in a low frequency conjugated form. The stimuli to be presented are in the left column. In the column at the right, the verb in its infinitive form is presented with its frequency index, as additional information for researchers.

Stimuli (n = 40):

HIGH FREQUENCY ROOT

HIGH FREQUENCY FORM.	(frequency of root)
1. *viene* (137)	- *venir* (585) [to come]
2. *habla* (84)	- *hablar* (527) [to talk]
3. *piensa* (45)	- *pensar* (392) [to think]
4. *siguiendo* (41)	- *seguir* (346) [to follow]
5. *dice* (339)	- *decir* (2.037) [to say]
6. *podemos* (71)	- *poder* (1.670) [to be able]
7. *sabe* (143)	- saber (705) [to know]
8. *parece* (261)	- *parecer* (543) [to seem]
9. *forman* (38)	- *formar* (187) [to form]
10. *empieza* (42)	- *empezar* (175) [to begin]

LOW FREQUENCY FORM.

11. *llevaríamos* (1)	- *llevar* (474) [to carry]
12. *diera* (1)	- *dar* (1.127) [to give]
13. *cuente* (1)	- *contar* (211) [to count]
14. *llamara* (1)	- *llamar* (437) [to call]
15. *sientas* (1)	- *sentir* (294) [to feel]
16. *hallemos* (1)	- *hallar* (185) [to find]
17. *olviden* (1)	- *olvidar* (120) [to forget]
18. *presenté* (1)	-*presentar* (177) [to present]
19. *pedimos* (1)	- *pedir* (162) [to ask]
20. *quisiesen* (1)	- *querer* (998) [to want]

LOW FREQUENCY ROOT

HIGH FREQUENCY FORM[15]

21. *ofenden* (2)	- *ofender* (15) [to offend]
22. *ensayando* (3)	- *ensayar* (8) [to reherse]

23. *navegando* (4)	- *navegar* (11) [to navegate]
24. *pregonan* (3)	- *pregonar* (9) [to proclaim]
25. *retroceden* (7)	- *retroceder* (10) [to go back]
26. *elaboraban* (2)	- *elaborar* (7) [to manufacture]
27. *simula* (3)	- *simular* (5) [to simulate]
28. *habitan* (2)	- *habitar* (5) [to inhabit]
29. *razonan* (3)	- *razonar* (8) [to reason]
30. *desconfio* (4)	- *desconfiar* (6) [to distrust]

LOW FREQUENCY FORM[16]

31. *incitemos*	- *incitar* (7) [to incite]
32. *golpearse*	- *golpear* (8) [to hit]
33. *expulsó*	- *expulsar* (5) [to expel]
34. *refuercen*	- *reforzar* (5) [to reinforce]
35. *remitan*	- *remitir* (10) [to forward]
36. *desata*	- *desatar* (5) [to untie]
37. *soplaban*	- *soplar* (5) [to blow]
38. *resignasen*	- *resignar* (6) [to resign]
39. *compadeciendo*	- *compadecer* (6) [to pity]
40. *regaron*	- *regar* (6) [to water]

Morphologically complex words: This kind of words allows us to check specifically the state of the sequence ...LOGOGRAPHIC INPUT LEXICON -> MORPHOLOGICAL CONVERSION -> LOGOGRAPHIC OUTPUT LEXICON... (Figure 1, page 24), that is the process of morphological decomposition.

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[15] Since these are low frequency verbs, what we took as high frequency forms of the verb are those forms that seem to be high frequency with respect to other forms of the same verb.

[16] As a low frequency variant we took a form that does not appear in Juilland and Chang-Rodríguez (1964), because in that dictionary frequencies lower than 1 are not included; therefore, we assumed that if a form does not appear it must have a very low frequency.

In this list we included words with derivational morphology as well as superlatives, diminutives, and augmentatives. In Spanish, derivational affixes generally change the word category; however, superlatives, diminutives and augmentatives do not. These last affixes are used to derived one word from another, but with the intention of adding a different sense to the original word; for example, to make it softer, more familiar, and even ironic in the case of a diminutive, or to intensify it as in the case of superlatives, etc. That is, these affixes add a semantic component to the word.

In this list, we have 24 words with derivational morphology where index of frequency has been controlled for, and 12 words with superlative, diminutive, and augmentative morphology from which we do not know their index of frequency since they are not included form Juilland and Chang Rodríguez' Dictionary.

Stimuli (n=36):

HIGH FREQUENCY	LOW FREQUENCY
1. *religioso* (51)	13. *partidario* (9)
2. *verdadero* (70)	14. *doctorado* (7)
3. *pensamiento* (127)	15. *individualismo* (7)
4. *movimiento* (102)	16. *escritura* (9)
5. *importancia* (89)	17. *suavidad* (9)
6. *conocimiento* (88)	18. *saludable* (9)
7. *personaje* (78)	19. *finalizar* (8)
8. *investigación* (77)	20. *hundimiento* (9)
9. *numeroso* (66)	21. *pensador* (6)
10. *maravilloso* (66)	22. *amarillento* (7)
11. *humanidad* (40)	23. *simplicidad* (8)
12. *industrial* (17)	24. *cercano* (8)
25. *grandota*	31 *pececito*
26. *gigantesco*	32. *viejecillo*
27. *nubarrón*	33. *blanquísimo*

28. *vivaracho*
29. *florecita*
30. *abuelito*
34. *utilísimo*
35. *malísimo*
36. *amabilísimo*

Compound words: In a manner similar to the list above, this list of stimuli will allow us to check further the state of the process of MORPHOLOGICAL CONVERSION (Figure 1, page 24). We do not know the index of frequency of these words because they are not included from the dictionary of Juilland and Chang Rodríguez (1964). However, we took them from El diccionario Grijalbo de la Lengua Castellana, and selected those that we assumed are known by our population.

Stimuli (n=20)

1. *cuentacuentos*
2. *sacapuntas*
3. *purasangre*
4. *aguamarina*
5. *montacarga*
6. *guardabosques*
7. *pelirrojo*
8. *caradura*
9. *rompehuesos*
10. *medianoche*
11. *portavión*
12. *limpiabotas*
13. *pisapapeles*
14. *matasano*
15. *cortauñas*
16. *sacacorchos*
17. *rascacielo*
18. *sujetalibros*
19. *quitamanchas*
20. *cubrecama*

Short and long words (L18): When a patient reads by a sublexical route, that is, in the case of the Latin alphabet, by converting graphemes to phonemes and from left to right, and if there is no problem with the patient's visual fields, the length of a word should not affect his/her reading (Kremin, 1980). If we detect that for the patient it is much easier to read short words than long words, we can suspect a lexical approach to reading.

Words with 12 or more letters, irrespective of their syllabic structure, are considered long words; and words with a maximum of 6 letters, irrespective of

syllabic structure, were classified as short words. All the words in this list are nouns, thus avoiding word category effects. We also controlled for index of frequency.

Stimuli (n=40):

HIGH FREQUENCY

SHORT	LONG
1. *patria* (56)	21. *organización* (56)
2. *ideal* (53)	22. *construcción* (53)
3. *misa* (21)	23. *responsabilidad* (21)
4. *pesar* (37)	24. *descubrimiento* (37)
5. *boca* (77)	25. *investigación* (77)
6. *lucha* (60)	26. *manifestación* (60)
7. *cargo* (41)	27. *interpretación* (41)
8. *actor* (40)	28. *procedimiento* (40)
9. *deber* (44)	29. *representación* (44)
10. *raíz* (50)	30. *independencia* (20)

LOW FREQUENCY

11. *caos* (8)	31. *correspondencia* (8)
12. *gozo* (6)	32. *agradecimiento* (6)
13. *malo* (7)	33. *reconstrucción* (7)
14. *lema* (7)	34. *individualismo* (7)
15. *espía* (5)	35. *desenvolvimiento* (9)
16. *danza* (10)	36. *establecimiento* (10)
17. *furia* (7)	37. *convencimiento* (7)
18. *ira* (7)	38. *administrador* (7)
19. *miel* (9)	39. *voluptuosidad* (9)
20. *pasta* (7)	40. *transparencia* (7)

4.2.4.4. Test N° 4: Reading aloud irregular words.

The regularization errors observed during the reading of irregular words are taken as evidence of a sub-lexical strategy for reading and difficulties with the lexical strategy. In Spanish, with the exception of the different readings given to the grapheme 'X', there are practically no irregularities in reading. Basically, all words can be read correctly with a sub-lexical strategy. Therefore, the observation of regularization errors in this language can be very problematic. However, this is not to say that the syndrome of superficial dyslexia does not exist in Spanish, or that its evaluation is a trivial matter. Thus we have been confronted with the option of constructing two lists of words that can be a source of irregularity for Spanish readers, although we are aware that these are not ecological in the sense that these kind of words are not usually found in Spanish texts. For the first list, we have adapted Lecours (1996) test of words of foreign origin for French people, and for the second list we developed or our own test taking the pattern of prosodic accentuation in Spanish words as a possible source of suprasegmental irregularity. As in the case of the other tests, these were tested in a pilot study and gave interesting results, as will be shown in Chapter 5 of this thesis.

Words of foreign origin (L1): Lecours (1996) refers to words sharing the same graphemes , but with different pronunciations depending on their context as "homography heterophonic." The French language contains a significant number of this type of words. In Lecours' protocol, the Test N° L1 consists of the reading of heterographic homophonic words. A number of words of foreign origin for the French language are included. Since hetographic homophonic words are very scarce in Spanish, we took advantage of the same idea of using words of foreign origin borrowed into Spanish.

We selected 20 words of foreign origin commonly found in Spanish texts taken from the dictionaries by Faitelson-Weiser (1987) and Huertas García (1974). We do not know the index of frequency of these words since, although we can find them in some Spanish dictionaries, they are systematically excluded from statistical analysis of the language. We have taken care to exclude those

that are too technical or uncommon. In addition, we took care to exclude those foreign words that can be read following the Spanish grapheme-to-phoneme correspondence rules. For example, the word 'BOY' was excluded because it can be read correctly following the grapheme-to-phoneme correspondence of Spanish words. In other words, we selected only those words that need to be lexicalized to be read correctly since they contain some graphemes that would be read differently in a Spanish context. The patient's level of education may be a determining factor in reading these stimuli correctly.

Stimuli (n=20):

1. *out*	11. *sweater*
2. *jet*	12. *manager*
3. *hit*	13. *boutique*
4. *jeep*	14. *sandwich*
5. *nylon*	15. *junior*
6. *baby*	16. *office*
7. *judo*	17. *burger*
8. *cowboy*	18. *hotdog*
9. *jazz*	19. *week-end*
10. *hobby*	20. *home run*

Words whose graphic accent mark has been erased: In Spanish the stress pattern of words that are not verbs is quite irregular. This information must be specified in the lexicon. Generally, the unmarked accent falls in the syllable next to the last if the word ends in a vowel or in the last syllable if the word ends in a consonant. However, this rule is not sufficient to determine the stress pattern of a word (Harris, 1983). With the purpose of maintaining the graphic representation of the word as close as possible to its pronunciation, that is, when a word has a marked tonic stress, this is indicated orthographically with a graphic accent mark over the vocalic nucleus of the stressed syllable. For example, he have words like

PISTOLA ("gun") with an unmarked accent, and EPÍSTOLA ("letter") with a marked tonic accent and hence an orthographic accent mark as well.

Based on this suprasegmental linguistic characteristic of Spanish, we created a test to force lexical reading. If we erased the graphic accent mark of words with marked tonic accent, the only way that these words can be read with their correct prosodic accentuation pattern is if they are recognized as lexical units. By erasing the accent mark of these words we force a kind of lexical reading.

The prediction is that patients who can read this kind of words correctly, that is with the correct stress pattern, are using a lexical strategy; and on the contrary, patients who are not able to read lexically will commit stress pattern regularization errors, that is, they will assign to these words the incorrect unmarked stress pattern of Spanish words. Miceli and Caramazza (1993) report the case of an Italian speaker who committed this kind of stress pattern regularization errors when reading in his language; moreover, in Chapter 5 of this thesis we report the case of a highly literate surface dyslexic who committed the expected regularization errors when reading the words from this list (Iribarren, Jarema, and Lecours, 1996). It has been observed in children learning to read, when are not very familiar with the use of the graphic accent mark, that they tend to make this type of stress pattern regularization error .

There are 60 words whose orthographic accent mark has been erased: 20 words with antepenultimate stress, 20 with penultimate and 20 with stress in the last syllable. Words should be mixed and presented at random one at a time, written on a card. Index of frequency has been controlled. Care was taken to exclude words that differ only in their stress pattern; e.g. "público" (public), publicó (he/she published) and "publico" (I publish).

Stimuli (n=60):

HIGH FREQUENCY

Antepenultimate	Penultimate	Last syllable
1. *espiritu* (219)	11. *arbol* (74)	21.*corazon*(154)
2. *pajaro* (27)	12. *carcel* (32)	22. *salon* (34)

3. *camara* (34)	13. *heroe* (62)	23.*ademas* (160)
4. *metodo* (98)	14. *inutil* (32)	24. *latin* (30)
5. *ultimo* (276)	15. *facil* (61)	25. *jardin* (61)
6. *peninsula* (139)	16. *angel* (48)	26. *millon* (69)
7. *clasico* (57)	17. *cadaver* (24)	27. *perdon* (21)
8. *proposito* (84)	18. *dificil* (93)	28. *algun* (615)
9. *tecnico* (33)	19. *debil* (24)	29. *aqui* (602)
10. *organo* (25)	20. *oido* (18)	30. *musulman*(20)

LOW FREQUENCY

Antepenultimate	Penultimate	Last syllable
31. *petalo* (5)	41. *docil* (5)	51. *caparazon* (5)
32. *satelite* (5)	42. *navio* (6)	52. *maton* (6)
33. *esporadico* (10)	43. *movil* (7)	53. *monton* (8)
34. *cosmico* (6)	44. *judio* (8)	54. *desvan* (8)
35. *timido* (7)	45. *martir* (7)	55. *frenesi* (10)
36. *vertigo* (7)	46. *habil* (7)	56. *reves* (11)
37. *ironico* (7)	47. *consul* (16)	57. *renglon* (6)
38. *dinamico* (7)	48. *lapiz* (8)	58. *burgues* (15)
39. *polvora* (8)	49. *distraido* (11)	59. *boton* (11)
40. *inedito* (8)	50. *fertil* (7)	60. *amen* (6)

4.2.4.5. Test N° 5: Reading aloud nonwords (L3):

The inability to read chains of syllables that do not belong to the vocabulary of a language, along with the preservation of the capacity to read real words, is taken as evidence of impairment at some level of the sub-lexical process of reading; i.e., ...ALPHABETIC INPUT REGISTER -> ALPHAPHONEMIC CONVERSION -> GRAPHEMIC INPUT REGISTER -> GRAPHOSYLLABIC ENCODING -> GRAPHOSYLLABIC INPUT REGISTER -> GRAPHOPHONOSYLLABIC CONVERSION... (Figure 1, page 24). On the other hand, the indistinguishable reading of words and

nonwords indicates that the sublexical route is intact. It is assumed for languages with irregular orthography that if a patient can read words , but not nonwords it is because he/she is using a lexical approach to reading. Since nonwords are novel forms without any semantic mental representation, they pose particular difficulties for a patient who cannot use a grapheme-to-phoneme decoding strategy. Somehow all those words that we do not know and that have no relationship with any word we already know, are read for the first time as if they were nonwords (Ardila Rosselli, and Pinzón, 1989). The production of lexicalization errors and the approximation behavior typical of patients with difficulties reading nonwords, are thought to be a strategy of reading by analogy with known words.

A patient's success or failure in reading nonwords depends on the type of nonwords, that is, it depends on the way the nonword is constructed and the type of task required (Friedman and Hadley, 1992). Therefore, we have constructed three lists of nonwords. However, they should be mixed and presented at random, one at a time.

List N° 1: **Legitimate nonwords** (L3): These nonwords consist of a string of syllables that respect the syllabic structure of Spanish[17] and do not have any visual or phonological similarity with any existing Spanish word. The purpose of this list of nonwords is to avoid the effect of reading by analogy with existing forms (Sebastián Gallés, 1991). This forces the patient to perform a non-lexical reading.

Originally a list of 100 of such forms were created with different degrees of syllabic complexity. We asked three native speakers of Spanish to judge them in terms of visual or phonological similarity with existing forms. 67 were selected as very dissimilar with existing forms. From the 67, we chose 20

[17] The Spanish syllable contains an optional onset of a maximum of two segments, and an obligatory rhyme of a maximum of three segments. Every rhyme has a vocalic nucleus. There is never a consonant in the position of the nucleus. The /s/ has a special status and can appear at the end of a well-formed syllable. In the onset of the syllable it is not possible to have two consonantal segments that are both [+alveolar] or both [+coronal, -continuos]. On the other hand, the Spanish syllable obeys all other universal restrictions of the syllable, for example, the sonority scale, etc. (Harris, 1983).

for this reading test, 10 for the repetition test, and 10 for the dictation test that we will present later.

Stimuli (n=20):

1. *clequi*
2. *pofo*
3. *trecne*
4. *nare*
5. *absto*
6. *sasche*
7. *buquire*
8. *jagomo*
9. *raclipo*
10. *maferi*
11. *trovoni*
12. *gifolu*
13. *cahomite*
14. *mecheclofé*
15. *trusomeno*
16. *betelimu*
17. *hestrala*
18. *frillexo*
19. *bemolla*
20. *teroque*

Lists N° 2 and N° 3: **Visually similar and non-similar nonwords**: Beauvois and Dérouesné (1979) designed two tests to evaluate the reading of nonwords when these are visually similar to real words or not at all similar. In their first test, the nonwords were handwritten in an unclear manner, but preserving more or less the visual configuration of the stimulus. In the second test, they inverted the order of letters of a real word to suppress any visual similarity with a real word. In an analogous manner, we created two lists of nonwords based on 20 high frequency real words: in the first list we change only one vowel, preserving thus the configuration of the original real word; and in the second list, we inverted the order of the syllables. We did not reverse the order of letters because that would produce nonwords with syllable structures not found in Spanish. In this last list, the nonword has lost any visual similarity with the original real word. Since in both lists the syllabic structure of the words is kept constant, this serves as a check of the syllabification decoding of the patients. With the nonwords in the second list we can check if the patient is using a strategy of visual analogy with real words to read the nonwords, and with the

nonwords in the third list we can check the state of the sequence ...GRAPHEMIC INPUT REGISTER -> GRAPHOSYLLABIC ENCODING -> GRAPHOSYLLABIC INPUT REGISTER -> GRAPHOPHONOSYLLABIC CONVERSION... (Figure 1, page 24). The prediction is that if the patient makes lexicalization errors when reading words in the second list and cannot read the nonwords in the third list, it is because he/she has difficulties with the sub-lexical route and might be attempting to read by analogy with real words. If he/she has difficulties with both lists, the patient has problems with the sub-lexical route and he/she is not capable of using the analogy strategy. On the other hand, it would be strange to find a patient who can read the words in the third list , but not those in the second list.

Stimuli (n=40):

ORIGINAL WORD	LIST 2	LIST 3
pintura (30)	1. *pentura*	21. *ratupin*
suelo (109)	2. *suilo*	22. *losue*
taller (31)	3. *tallor*	23. *llerta*
iglesia (85)	4. *iglusia*	24. *siaglei*
colegio (31)	5. *colugio*	25. *gioleco*
teatro (79)	6. *toatro*	26. *trotea*
página (72)	7. *pógina*	27. *nagipá*
sangre (74)	8. *sungre*	28. *gresan*
fuego (66)	9. *fuigo*	29. *gofue*
balcón (53)	10. *balcún*	30. *cónbal*
montaña (51)	11. *montiña*	31. *ñatamon*
pregunta (46)	12. *pragunta*	32. *tagunpre*
barco (53)	13. *berco*	33. *cobar*
horizonte (35)	14. *horizente*	34. *tezonriho*
biblioteca (35)	15. *bablioteca*	35. *catebliobi*
bandera (34)	16. *bendera*	36. *radeban*
documento (33)	17. *documinto*	37. *tomencudo*
carretera (33)	18. *carretora*	38. *raterreca*

ministerio (32)	19. *minusterio*	39. *riotenismi*
policía (31)	20. *policéa*	40. *cíalipo*

4.2.4.6. Test N° 6: Matching words with homophonous nonwords:

Dérouesné and Beauvois (1979) found a dissociation in the reading of nonwords between those that were homophones of words and those that were not. They concluded that in the sub-lexical route there must be some phonological processes and some visual processes that act independently of each other. According to Denes, Cipolotti, and Semenza (1987), who found an advantage in reading nonwords when these were homophonous with real words, it seems that there must be two types of lexical representations, one purely phonological and another purely orthographic; that is, in their opinion the problem is nor found at the sublexical level, but at the lexical level. According to Lecours (1996) the advantage in reading nonwords homophonous with real words somehow involves the LOGOPHONIC OUTPUT LEXICON. In order to check its functioning, Lecours designed a test (L13) that consists in asking the patient to choose between a word and a nonword homophonous to a target word. The distracter is visually similar to the target word. The hypothesis is that if the homophony facilitates the reading of the nonword it is because the LOGOPHONIC OUTPUT LEXICON is involved and, therefore, it is in good condition. We have changed Lecours' test somewhat and used two nonwords as possible answers instead: one homophonous to the target word and the other one visually similar to it. In this manner we increased the level of difficulty and focused more on the LOGOPHONIC OUTPUT LEXICON.

In this test each series must be written on a card and presented one by one. There are 14 questions, the first two are for training the patient and, of course, must not be counted for the analysis. The position of correct response has been counterbalanced. The patient must point to the correct choice or simply say "a" or "b."

Stimuli (n= 14 preguntas):

WORDS	HOMOPHONOUS NONWORDS	
i) *bello*	a. *veyo*	b. *belo*
ii) *hijo*	a. *igo*	b. *ijo*
1. *yeso*	a. *lleso*	b. *llema*
2. *alcohol*	a. *alcova*	b. *alkol*
3. *pureza*	a. *puresa*	b. *bajesa*
4. *herido*	a. *erid*	b. *kerido*
5. *vino*	a. *bano*	b. *bino*
6. *libro*	a. *livro*	b. *lavor*
7. *hueco*	a. *ueco*	b. *uevo*
8. *gitano*	a. *jigante*	b. *jitano*
9. *zorra*	a. *sorra*	b. *surra*
10. *bujía*	a. *legía*	b. *vugía*
11. *llave*	a. *yubia*	b. *yabe*
12. *carpa*	a. *karpa*	b. *kaspa*

4.2.4.7. Test N° 7: Discrimination of homophonous words in context:

One method of evaluating the condition of the LOGOGRAPHIC INPUT LEXICON (Figure 1, page 24) is with reading tasks that require the patient to differentiate between two homophonous words presented in context. That is, enough semantic information is given for the patient to select the appropriate orthography of the correct answer. The only way the patient can solve this problem is by activating his/her orthographic memory for words that he/she understands.

This kind of task is particularly difficult for surface dyslexics, because they tend to access the meaning of words by their oral production, and since between homophonous words there is no difference in pronunciation, they get very confused. Masterson, Coltheart, and Meara (1985) observed this type of confusion in a surface dyslexic speaker of Spanish. Since in the Spanish

language there is almost no irregularity when reading, homophonous confusion can be very useful to detect non-lexical reading.

In order to construct this test we selected a list of pair of homophonous words from the Diccionario de sinónimos, antónimos y paronimios by Doezis (1986) and from the orthographic manual, Ortografía metódica de la lengua española, by Huertas García (1974). For the selection of these pairs of words we took into consideration that both words belong to the same grammatical category whenever possible, and that they were not uncommon words. Then we wrote several sentences containing one of the pair of words with enough semantic clues to identify the correct orthographic form. We asked a group of three independent judges to select those sentences that were the clearest ones. With these we wrote the sentences, leaving a blank in the position of the homophonous word and placing the two choices under the sentences. We are aware that since there are two choices per sentence, there is a probability of answering correctly 50% of the time just by chance. This must be taken into consideration for the analysis. Order of correct choice was counterbalanced and randomized.

Stimuli (n = 25 questions):

1. *Juan* _____ *la puerta de su casa.*

   a. *abría* b. *habría*

2. *En el patio central está el* _____ *de la bandera.*

   a. *hasta* b. *asta*

3. *María tiene dos hijos, una hembra y un* _____.

   a. *barón* b. *varón*

4. *El atardecer es muy* _____.

   a. *vello* b. *bello*

5. *La papelera es para _____ la basura.*

a. *botar* b. *votar*

6. *Toda la ropa no _____ dentro de la maleta.*

a. *cave* b. *cabe*

7. *El río se salió completamente de su _____.*

a. *cauce* b. *cause*

8. *Con el uso del _____ se ubicó al galeón sumergido.*

a. *censor* b. *sensor*

9. *La oficina _____ a las 5 p.m.*

a. *sierra* b. *cierra*

10. *La inflación llegó al _____ por ciento.*

a. *cien* b. *sien*

11. *Es posible que _____ por ese candidato.*

a. *vote* b. *bote*

12. *El que no oye _____, no llega a viejo.*

a. *consejo* b. *concejo*

13. _____ *es humano.*

a. *Errar* b. *Herrar*

14. *El teléfono está _____ del escritorio.*

a. *enzima* b. *encima*

15. *El cantante _____ su último disco ayer.*

a. *gravó* b. *grabó*

16. *Solamente tengo _____ bolívares en la cartera.*

a. *sien* b. *cien*

17. *¿Dónde está la _____ de cocinar de aluminio?*

a. *hoya* b. *oya*

18. *La _____ es una ballena muy peligrosa.*

a. *orca* b. *horca*

19. *Es mejor no tener _____ en asuntos ajenos.*

a. *ingerencia* b. *injerencia*

20. *Juan preparó la _____ para hacer el pan.*

a. *masa* b. *maza*

21. *Durante la tormenta cayó un _____ en la antena.*

a. *rayo* b. *rallo*

22. *Todavía no he _____ las fotos.*

a. *rebelado* b. *revelado*

23. *Algunos remedios son muy dificiles de _____.*

a. *injerir* b. *ingerir*

24. *Se me rompió la _____ de café de porcelana.*

a. *taza* b. *tasa*

25. *Los esclavos se _____.*

a. *revelaron* b. *rebelaron*

4.2.4.8. Test N° 8: Vocabulary comprehension.

This test is used to determine the state of the access from the LOGOGRAPHIC INPUT LEXICON to the SEMANTIC KNOWLEDGE (Figure 1, page 24). In this test, vocabulary comprehension will be examined, and in the next test, paragraph comprehension will be checked.

This test consists in the selection of the appropriate word from three possible choices. There is a phonologic/orthographic distracter and a semantic distracter. We selected from the list of words from Test N° 3 in this protocol 20 nouns, 5 from each group (i.e., controlling for level of concretion and index of frequency), and with these words we constructed the questions. We asked three independent judges to determine the clarity of the correct answer and the distracters. Two questions are added at the beginning for training. Order of correct response is counterbalanced. Each of the questions must be written on a separate card and must be presented in random order.

Stimuli (n= 20 questions):

i) *Producto del mar que se come*:

a. *pollo* b. *pescuezo* c. *pescado*

ii) *Acto de heroísmo*:

a. *hazaña* b. *lasaña* c. *engaño*

1. *Clase de árbol:*

a. *tronco* b. *pino* c. *vino*

2. *Parte del cuerpo*:

a. maleza *b. sombrero* *c. cabeza*

3. *Que se lee:*

a. lápiz *b. libro* *c. liebre*

4. *Para beber:*

a. agua *b. jaguar* *c. tomate*

5. *Elevación natural de terreno*:

a. playa *b. montaña* *c. montuno*

6. *Para conocer la fecha:*

a. caldero *b. mapa* *c. calendario*

7. *Para coser:*

a. aguja *b. martillo* *c. ajuar*

8. *Catálogo de información:*

a. follaje *b. libreta* *c. folleto*

9. *Para recostar la cabeza:*

a. almanaque *b. cobija* *c. almohada*

10. *Mano del animal felino*:

a. jarra *b. garra* *c. cola*

11. *Duración de las cosas:*

a. tercio *b. reloj* *c. tiempo*

12. *Premiar virtudes y castigar culpas*:

a. milicia *b. justicia* *c. sanción*

13. *Contrario a muerte:*

a. vicio *b. suerte* *c. vida*

14. *Idea sobre una cosa:*

a. concepto *b. causa* *c. precepto*

15. *Sinónimo de causa:*

a. conciencia *b. efecto* *c. razón*

16. *Contrario de pesimismo:*

a. oportunismo *b. funesto* *c. optimismo*

17. *Acontecimiento imprevisto:*

a. calidad *b. calamidad* *c. casualidad*

18. *Ausencia de miedo:*

a. cobardía *b. coraje* *c. cortejo*

19. *Que hace falta:*

a. escasez *b. exceso* *c. escarnio*

20. *Mala utilización de algo:*

a. apuro *b. obtuso* *c. abuso*

4.2.4.9. Test N° 9: Comprehension of paragraph:

This test has been drawn directly from Ardila, Rosselli, and Puente (1994), from their manual for the neuropsychological evaluation of Spanish speakers because we think that the level of difficulty of the text is adequate for our population as well. It consists of a short paragraph with four multiple-choice questions. The text and the questions must be given to the patient on a piece of paper .

Text

EL GUSANO Y LA MARIPOSA

Dos gusanos cayeron en el agua. Uno de ellos pensó que era inútil tratar de salvarse ya que nunca lograría llegar hasta la orilla. Se dejó entonces llevar por la corriente y se ahogó. El otro trató de salir. Pensó que quizás lo lograría. Que era mejor intentar que dejarse lleva por la corriente y ahogarse inevitablemente. Entonces nadó con todas sus fuerzas por un largo rato. Cuando ya pensaba que no podía más y que aún la orilla estaba muy lejos, sintió que se convertía en mariposa y que le aparecían unas enormes alas en su espalda. Entonces salió volando y escapó de morir ahogado.

1. *¿Cuántos gusanos cayeron al agua?*

   a. uno
   b. dos
   c. tres

2. *¿Por qué se ahogó el primer gusano?*

   a. porque no sabía nadar
   b. porque pensó que sería inútil luchar
   c. porque era más débil

3. *¿Qué paso con el segundo gusano?*

   a. también se ahogó
   b. creyó que se ahogaría
   c. trató de salir

4. *¿Cómo se salvó el otro gusano?*

   a. porque se convirtió en mariposa
   b. porque pudo nadar
   c. porque lo ayudó una mariposa

4.2.4.10. Test N° 10: Decomposition of words into syllables:

We consider that the most direct way to evaluate certain sub-lexical processes is by the use of tasks that require the segmentation of the words. For this purpose, we have designed two tests, this one for the segmentation of words into syllables, and Test N° 11 for the segmentation of words into morphemes.

According to the research of Morais et al. (Adrián, Alegría, and Morais, 1995; Bertelson and de Gelder, 1989; and Morais, Bertelson, Cary, and Alegría, 1986), with populations of illiterates, it seems that the metalinguistic consciousness of segmentation develops from the acquisition of reading alphabetic systems. These researchers observed that illiterate subjects in comparison with literate subjects, speakers of Spanish and Portuguese, were capable of performing tasks of rhyme and rhythm, but showed great difficulty in tasks of segmentation and recognition of phonemes and syllables. This finding points towards the particularization of this type of knowledge. Segmentation tasks can help us to check the state of the sub-lexical route of reading, especially that of the sequence from the GRAPHOSYLLABIC ENCODING to the GRAPHOSYLLABIC INPUT REGISTER (Figure 1, page 24).

In the selection of the stimuli we controlled for the index of frequency of the words, and for the index of frequency of the syllables, based on Guerra (1983). We tried to include syllables of different levels of complexity in equal numbers in the high frequency and low frequency words.

In this test, the patient will be asked to use a stroke mark to indicate the separation of syllables of a word. The words should be written all in capital letters and with a space between all letters of the word. They must be presented in random order.

Stimuli (n = 24):

HIGH FREQUENCY	LOW FREQUENCY
1. *hombre* (941)	13. *sobrenombre* (6)
2. *instrumento* (67)	14. *reconstrucción* (7)
3. *creer* (567)	15. *proveer* (7)
4. *descripción* (111)	16. *recepción* (6)

5. *ahora* (543)
6. *ciudad* (318)
7. *maestro* (130)
8. *dirección* (71)
9. *país* (221)
10. *gobierno* (183)
11. *pensamiento* (127)
12. *agua* (156)
17. *ahogar* (15)
18. *alianza* (6)
19. *audaz* (6)
20. *predilección* (6)
21. *maíz* (7)
22. *incierto* (7)
23. *lienzo* (7)
24. *menguado* (5)

4.2.4.11. Test N° 11: Decomposition of words into morphemes.

There are several hypotheses with respect to the composition of the mental lexicon. There are those who postulate that the mental lexicon contains all words in all their variations; there are others who propose a more economical lexicon composed of roots of words, affixes, and the rules of combinations. Both positions at the extremes are problematic (Spencer, 1991). However, there seems to be certain agreement in that morphological processes are independent of orthographic and phonological representations, that the morphological structure of a word is involved in word recognition, and that inflectional morphology is more transparent than derivational morphology (Feldman, 1994). Morphological errors observed in aphasic syndromes favor the view of morphological decomposition of the lexicon; however, in a study of multilingual aphasics Kehayia, Jarema, and Kadzielawa (1990) argue that the kind of morphological errors observed are closely linked to the language typology of the patient.

The purpose of this test of morphological decomposition is to evaluate the state of the MORPHOLOGICAL CONVERSION process (Figure 1, page 24). Nevertheless, due to the complexity of morphological processes and to the structure of the mental lexicon of each individual, this could involve the LOGOGRAPHIC INPUT LEXICON as well. In this particular test, we will evaluate the explicit knowledge of the morphology of the words. We are aware that his knowledge is closely related to the level of education of the person, and to the morphological structure of the words.

The patient is asked to indicate either the presence or absence of an affix (prefix or suffix) in a word . There are three types of words: in the first type, the morphological composition of the word is "transparent," that is, it is not problematic to indicate the presence of an affix (e.g. "in-convenient"). In the second type, the morphological structure of the word is "opaque," that is, although we can assume that it derives from a morphological process, its decomposition does not make sense (e.g. "in-hibit"). The third type of words are not decomposable, but the beginning or end of the word is orthographically similar to an affix (e.g. "Indian"). Most probably in the second and third type of words there are some that are derived from morphological processes; however, in their use nowadays they do not have componential sense.

Each word must be written separately in a card and presented in random order. There are a total of 60 stimuli, and in addition there are 6 items for training.

Stimuli (n=60):

	TRANSPARENT	OPAQUE	N/D
PREFIX	i) *desnutrir*	ii) *exprimir*	iii) *prelado*
SUFIX	iv) *hablador*	v) *fatal*	vi) *almidón*
PREFIX	1. *inconexo*	11. *incluir*	21. *indio*
	2. *exesposa*	12. *explicar*	22. *éxito*
	3. *invisible*	13. *inferior*	23. *incienso*
	4. *deformar*	14. *denuncia*	24. *decente*
	5. *desmentir*	15. *despertar*	25. *desmayo*
	6. *proclamar*	16. *progreso*	26. *prosaico*
	7. *presentir*	17.*presurizar*	27. *préstamo*
	8. *acromático*	18. *abandono*	28. *abadesa*
	9. *coeducar*	19. *comunicar*	29. *comida*
	10. *supernova*	20. *superficie*	30. *superchería*
SUFIJOS	31. *flechazo*	41. *sablazo*	51. *embarazo*
	32. *angelito*	42. *nietecito*	52. *erudito*

33. *aplicable*	43. *formidable*	53. *cable*
34. *colorido*	44. *frígido*	54. *bandido*
35. *ropaje*	45. *oleaje*	55. *peaje*
36. *ilusionar*	46. *cuidar*	56. *espaldar*
37. *paredón*	47. *bobalicón*	57. *algodón*
38. *salvajez*	48. *vejez*	58. *alferéz*
39. *millonada*	49. *redada*	59. *nómada*
40. *calladito*	50. *bendito*	60. *ejército*

4.2.4.12. Test N° 12: Recognition of morphological relationship.

In Test N° 11, we tested the explicit knowledge of the morphology of words. In Test N° 12, on the contrary, we will simply test the patient's implicit knowledge of the morphology of words. Therefore, the patient will be asked merely to indicate if a pair of words is related or not. Two words are considered related morphologically if they share the same root (Beauvillain and Segui, 1992). For this test we have prepared a list of 24 pairs of words, 12 pairs related in terms of prefixation and 12 pairs related in terms of suffixation, and a list of 24 pairs of words with no relationship at all, but with orthographic similarity at the beginning or at the end of the word. We call the first group of 24 pairs of words "legal relationship" (e.g. "tie – untie") and the second "illegal relationship" (e.g. "ant – anterior"). Pairs of words must be written on separate cards and presented in random order.

Stimuli (n = 48 pairs):

LEGAL PAIRS

PREFIX	SUFIX
1. *abrigo - desabrigo*	13. *arroz - arrozal*
2. *nutrir - desnutrir*	14. *encanto - encantador*
3. *precio - aprecio*	15. *guerra - guerrero*
4. *brollo - embrollo*	16. *hijo - hijastro*

5. *mensual - bimensual*
6. *médico - paramédico*
7. *distante - equidistante*
8. *marino - submarino*
9. *nacional - internacional*
10. *cubrir - descubrir*
11. *cerrar - encerrar*
12. *proyecto - anteproyecto*
17. *dolor - doloroso*
18. *mariposa - mariposear*
19. *baile - bailable*
20. *metal -metálico*
21. *casa - casucha*
22. *blanco - blanquear*
23. *incluir - inclusive*
24. *norma - normal*

ILLEGAL PAIRS

25. *abrir - desabrido*
26. *bajada - embajada*
27. *basta - subasta*
28. *mata - autómata*
29. *acto - exacto*
30. *oso - endoso*
31. *cesto - incesto*
32. *mayo - desmayo*
33. *hogar - desahogar*
34. *ojo - enojo*
35. *clavo - esclavo*
36. *tinta - extinta*
37. *mesa - mesada*
38. *ave -avería*
39. *bote - botella*
40. *cacho - cachorro*
41. *canto - cantimplora*
42. *codo - codicia*
43. *pan - pandereta*
44. *cerro - cerradura*
45. *cepo - cepillo*
46. *cono - conocer*
47. *conde - condena*
48. *vaca - vacación*

4.2.5. Writing evaluation.

Generally, writing is evaluated along with reading as if it were a skill that is completely dependent on it. Writing disturbances are seldom treated by themselves with the importance they deserve. It is true that these two skills are very closely related, that they are acquired simultaneously, and that they share a number of sub-processes. However, writing involves certain particular sub-processes that differ from those of reading (Ellis, 1984).

However, writing is much less practiced than reading, and it depends much more on the level of education of the person than reading does. In addition, it is not uncommon that patients with brain lesions in the left hemisphere have motor problems with the right arm. This further complicates the evaluation of writing skills in these patients. Whenever possible, then, it is advisable to evaluate writing capabilities with both hands. It is also advisable to ask for samples of the patient's writing before the brain injury. This will help to see the pre-morbid writing skills, and will allow for the proper comparisons and conclusions to be drawn.

It has been our experience that when patients can recognize their writing errors, they will have the natural tendency to try to erase them and correct them if possible. In this manner some valuable information for the researcher might be lost. Our recommendation, then, is to give them a writing instrument that can not be erased, but it is necessary also to reassure the patient these errors are useful information for his/her diagnosis.

4.2.5.1. Test N° 13: Spontaneous writing.

Name and signature: This entails a type of automatic writing different from the writing of other words that require a little more planning. Other over-learned words can also be asked to be written, for example, address, telephone number, birthday, etc.

Short paragraph: This can give us an idea of the general state of the patient's writing. Two or three sentences about an open topic, for example, about what happened to him, will be sufficient.

4.2.5.2. Test N° 14: Copying of words (D15).

The purpose of this task is to check the state of the ALPHABETIC OUTPUT REGISTER (Figure 2, page 27). In other words, we want to see if the patient is capable of producing allographs, or if he/she is copying as if making a drawing. This test consists of three sections: in the first, the patient is asked to

copy five high frequency words as he/she likes; in the second section, the patient is asked to copy five words written in print of different length into his/her own handwriting, and five other words written in handwriting into capital letters; and in the third section, he/she is asked to copy two sentences.

Stimuli (n = 15 words, and 2 sentences)

FREE COPY:

1. *masa* (73)
2. *hombre* (941)
3. *verdad* (326)
4. *trabajo* (243)
5. *naturaleza* (73)

FROM PRINTO TO HANDWRITING:

6. SUMA
7. CHEQUE
8. PLANTA
9. MUCHACHO
10. SUBSTANCIA

FROM HANDWRITING TO PRINT

11. Dado
12. Astro
13. Puerto
14. Religión
15. Maravilloso

SENTENCES:

16. *La pelota cayó en el patio.*
17. *A Cristina le hicieron una operación del corazón abierto con mucho éxito en el hospital de San Juan de Dios.*

4.2.5.3. Test N° 15: Copying of nonwords

In order to examine the state of the sub-lexical route of copying, the patient is asked to copy the following nonwords: eight legitimate nonwords and eight nonwords homophonous with real words. If these two types of words are copied differently, particularly if homophonous nonwords are copied better, we can suspect the intervention of the LOGOPHONIC INPUT LEXICON (Figure 2, page 27), but such conclusion depends on the patient's response.

Stimuli (n = 16)

LEGITIMATE NONWORDS	HOMOPHONOUS NONWORDS
1. *reco*	9. *baye*
2. *vesmaca*	10. *huniko*
3. *mequinasa*	11. *evilla*
4. *hetomecho*	12. *horijen*
5. *ejusca*	13. *obcerbar*
6. *trasmela*	14. *vriyante*
7. *propirro*	15. *havertura*
8. *guñestón*	16. *konfiansa*

4.2.5.4. Test N° 16: Spelling of words.

Spelling a word is a skill that differs from reading or writing it (Newcombe and Marshall, 1985; Caravolas, 1993). We have already described "spelling dyslexia," which manifests itself as the ability of a patient to spell a word that he/she cannot read later (McCarthy and Warrington, 1990). This test consists of two parts.

In the first part of the test, the researcher spells a word to the patient and then asks him/her to say the word aloud. We want to evaluate mainly the state of the sequence from the PHONOLITERAL INPUT REGISTER to the LOGOPHONIC OUTPUT LEXICON. This route is not represented n Figure 2,

but in Lecours' model (1996) it is not excluded.[18] This is another way to evaluate the state of the "Orthographic Buffer" postulated by Caramazza et al. (Caramazza and Miceli, 1990; Miceli, Silveri and Caramazza, 1987; and McClosky et al., 1994).

In the list of stimuli, the number of letters increases progressively; the same order of presentation must be kept. The number of letters and the index of frequency of the word is in parentheses.

Stimuli (n = 8)

1. *no* (2, 6.900)
2. *una* (3, 3.780)
3. *día* (3, 696)
4. *cosa* (4, 539)
5. *padre* (5, 271)
6. *estado* (6, 265)
7. *nombre* (6,224)
8. *problema* (8,173)

In the second part, the researcher gives a word to the patient and asks him/her to spell it. In this manner, it would be possible to evaluate the state of the course from LOGOPHONIC INPUT LEXICON to the PHONOLITERAL OUTPUT REGISTER, not represented either in the figures we have chosen from Lecours (1996). Although it seems to be basically an oral task, it certainly involves the orthographic-lexical knowledge indispensable to write a word correctly. As in the first part of this test, the order of presentation with respect to degree of complexity must be respected, but the order of presentation of regular and irregular words can be mixed.

Stimuli (n = 10)

REGULAR	IRREGULAR
1. *niño* (4, 158)	2. *paso* (4, 123)
3. *pecho* (5, 48)	4. *curso* (5, 48)
5. *comedia* (6, 49)	6. *célula* (6, 40)
7. *catedral* (8, 29)	8. *tragedia* (8, 28)
9. *matrimonio* (10, 56)	10. *habitación* (10, 56)

[18] Lecours (1996) has other graphic representations of his model; however, we have chosen

4.2.5.5. Test N° 17: Dictation of letters (D6).

The purpose of this test is to examine the functioning of the sequence from the PHONOLITERAL INPUT REGISTER to the ALPHABETIC OUTPUT REGISTER (Figure 2, page 27). We use the same letters as those in Test N° 1 are used.

4.2.5.6. Test N° 18: Dictation of syllables.

The purpose of this test is to check the state of the route from the PHONOSYLLABIC INPUT REGISTER to the GRAPHOSYLLABIC OUTPUT REGISTER (Figure 2, page 27). For this the writing of syllables to dictation is used. Ten syllables with different levels of complexity and frequency index were chosen: five of which can be written in only one way, and the other five can e written in two ways.

Stimuli (n=10)

REGULAR	IRREGUALR
1. /ma/ = ma	6. /bo/ = vo, bo
2. /die/ = die	7. /sie/ = cie, sie
3. /han/ = jan	8. /hen/ = jen, gen
4. /ren/ = ren	9. /jo/ = llo, yo
5. /trans/ = trans	10. /bue/ = bue, vue

4.2.5.7. Test N° 19: Dictation of words.

In Lecours' protocol of evaluation the dictation of different types words is studied in tests D1, D2, D4, D5, D8, D16, D17, D18, and D19. However, since Spanish orthography presents different problems than those of French, and we controlled for index of frequency, grammatical category, level of concretion, length, morphological complexity, and particularly regularity in a different manner than that used by Lecours, we consider that Lecours' tests are included in Test N° 19.

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only the two most relevant for our work.

The hypotheses assumed by this evaluation are the same as those proposed for the reading tests: when effects of word category (grammatical class, length, index of frequency, etc) are observed, we can suspect a writing process mediated by lexical processes. If these effects are not observed, but on the other hand, we observe errors of "regularization" (i.e., phonologically legal orthographic errors), then we can assume that the patient's writing might be mediated by a sub-lexical strategy, and moreover, we may suspect difficulties with the lexical route of writing.

We have decided to control for the "regularity" effect across all the different types of word categories, in the same manner that we control for the index of frequency effect. In section 4.1.2. of this chapter, we described the different sources of orthographic irregularities found in Spanish. However, we have decided to include as regular words those containing the syllables "ca," "co," "cu," "que" and "qui," because, although the phoneme /k/ can also be written with the letter K, the frequency in which this letter is used to represent this sound in Spanish is so low that the probability that a patient will write a word with K is very small.

In an analogous manner to the reading tests, words appear classified by grammatical category, regularity, frequency degree, etc.; the rationale for the selection of stimuli is basically the same also. However, the stimuli must be dictated in a random order. There are fewer stimuli than in the reading tasks, because writing is more demanding than reading. Whenever possible, the same words from the reading tests are used; they are marked with an '+' after the word. This is a way of observing the behavior of patients dealing with the same stimuli in different modalities.

Nouns:

Stimuli (n=48)

CONCRETE	REGULAR	IRREGULAR
H.F.[19]	1. *mano* (297)+	7. *ventana* (73)+
	2. *montaña* (51)+	8. *cabeza* (142)+
	3. *agua* (156)+	9. *ciudad* (318)+
	4. *escuela* (100)+	10. *habitación* (56)+
	5. *carta* (103)+	11. *suelo* (109)
	6. *puerta* (153)	12. *llave* (30)
L.F.	13. *calendario* (6)+	19. *archivo* (7)+
	14. *guitarra* (8)	20. *almohada* (5)+
	15. *aguja* (11)+	21. *globo* (7)+
	16. *cheque* (8)	22. *herramienta* (7)+
	17. *regalo* (7)	23. *pescado* (8)+
	18. *ferrocarril* (9)	24. *hierba* (9)
ABSTRACT		
H.F.	25. *tiempo* (504)+	31. *honor* (74)+
	26. *realidad* (193)+	32. *justicia* (64)+
	27. *recuerdo* (66)	33. *vida* (748)+
	28. *propiedad* (52)	34. *confianza* (36)+
	29. *culpa* (47)	35. *necesidad* (77)
	30. *literatura* (78)	36. *leyenda* (53)
L.F.	37. *reclamo* (8)+	43. *abuso* (9)+
	38. *quietud* (9)	44. *coraje* (7)+
	39. *ternura* (16)	45. *escasez* (6)+
	40. *decoro* (7)	46. *hazaña* (10)+
	41. *repertorio* (12)	47. *venganza* (6)+

[19] H.F.= High frequency, L.F.= Low frequency.

	42. *cordialidad* (8)	48. *traición* (10)

Adjectives:

Stimuli (n=24)

	REGULAR	IRREGULAR
H.F.	1. *igual* (155)	13. *cierto* (288)
	2. *grande* (795)+	14. *ligero* (62)
	3. *moderno* (99)	15. *nuevo* (131)+
	4. *popular* (73)+	16. *especial* (74)+
	5. *perfecto* (57)	17. *hermoso* (74)+
	6. *natural* (126)	18. *siguiente* (137)
L.F.	7. *pendiente* (7)+	19. *cohibido* (7)+
	8. *finito* (11)	20. *cínico* (8)+
	9. *maduro* (5)+	21. *negativo* (10)
	10. *crudo* (6)+	22. *severo* (11)
	11. *rendido* (14)	23. *apoyado* (9)
	12. *galante* (9)	24. *incesante* (9)

Adverbs:

Stimuli (n=24)

	REGULAR	IRREGULAR
H.F.	1. *tampoco* (112)+	13. *todavía* (162)+
	2. *pronto* (142)+	14. *siquiera* (34)
	3. *mucho* (123)+	15. *ayer* (99)
	4. *debajo* (43)	16. *encima* (65)+
	5. *apenas* (68)	17. *quizás* (115)+
	6. *durante* (193)	18. *bastante* (38)+
L.F.	7. *entretanto* (14)+	19. *viceversa* (7)+
	8. *mediante* (16)+	20. *despacio* (11)+
	9. *enfrente* (9)+	21. *basta* (15)+

10. *adentro* (5)+	22. *salvo* (8)
11. *claramente* (14)	23. *vagamente* (10)
12. *temprano* (12)	24. *enseguida* (14)

Function words:

Stimuli(n=20)

REGULAR	IRREGULAR
1. *ni* (603)	11. *ya* (1.313)
2. *de* (35.144)	12. *ella* (3.043)
3. *con* (4.667)	13. *cuyo* (147)
4. *pero* (1.792)	14. *hasta* (613)
5. *otro* (220)	15. *hacia* (203)
6. *todo* (1.951)	16. *según* (166)
7. *ante* (211)	17. *demás* (86)
8. *tanto* (264)	18. *también* (633)
9. *porque* (831)	19. *siempre* (558)
10. *durante* (193)	20. *entonces* (262)

Verbs:

Stimuli (n=36)

	REGULAR	IRREGULAR
H.F.	1. *dando* (69)	13. *parece* (261)
	2. *quiero* (160)	14. *empieza* (42)
	3. *corresponde* (38)	15. *hablando* (41)
	4. *tendría* (27)	16. *pensaba* (19)
	5. *encuentra* (39)	17. *conozco* (28)
	6. *mirando* (43)	18. *sabemos* (50)
L.F.	7. *tolerando** [20]	19. *hallemos* (1)

[20] Asterisks indicate that the index of frequency of these forms of the verb is below 1/20.000, and

8. *acrediten* (4)
9. *frecuentando* (1)
10. *comparte* (2)
11. *plantaron* (1)
12. *recurrid* (1)
20. *incitemos**
21. *refuercen **
22. *soplaban **
23. *resignasen **
24. *bastaban* (1)

SHORT FORMS OF INFLECTED FORMS:

25. *leo* (4)
26. *caen* (14)
27. *une* (7)
28. *toma* (25)
29. *queme* (1)
30. *den* (9)
31. *leyó* (9)
32. *oye* (19)
33. *iba* (99)
34. *subo* (6)
35. *calla* (4)
36. *veía* (3)

Morphologically complex words:

Stimuli (n=30):

	REGULAR	IRREGULAR
H.F.	1. *fundamental* (39)	13. *naturaleza* (73)
	2. *importante* (81)	14. *verdadero* (133)
	3. *intelectual* (70)	15. *nacional* (116)
	4. *determinado* (56)	16. *movimiento* (102)
	5. *independiente* (29)	17. *sentimiento* (95)
	6. *finalidad* (18)	18. *actividad* (60)
L.F.	7. *comprendido* (7)	19. *licenciado* (9)
	8. *alojamiento* (7)	20. *hundimiento* (9)
	9. *mandato* (11)	21. *debilidad* (15)
	10. *partidario* (9)	22. *humorístico* (6)

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therefore do not appear in the dictionary Juilland y Chang Rodríguez (1964), although some other forms of the verb appear and have a low frequency index.

11. *triunfante* (12)
12. *dominante* (10)
23. *incesante* (9)
24. *precedente* (9)

CONTROL WORDS

25. *distrito* (13)
26. *embarazo*
27. *erudito* (11)
28. *peaje*
29. *cable*
30. *algodón*

Compound words:

Stimuli (n=12)

REGULAR	IRREGULAR
1. *medialuna*	7. *aguafiestas*
2. *correcamino*	8. *lavaplatos*
3. *montacarga*	9. *rompecabeza*
4. *caradura*	10. *tragavenado*
5. *aguamarina*	11. *sordomudo*
6. *medianoche*	12. *cubrecama*

Short and long words:

Stimuli (n=12):

SHORT	LONG
1. *ideal* (53)+	7. *construcción* (53)+
2. *misa* (21)+	8. *responsabilidad* (21)+
3. *lucha* (60)+	9. *manifestación (*60)+
4. *gozo* (6)+	10. *agradecimiento* (6)+
5. *miel* (9)+	11. *desenvolvimiento* (9)+
6. *furia* (7)+	12. *transparencia* (7)+

4.2.5.8. Test N° 20: Dictation of nonwords (D3).

In this test we have used only legitimate nonwords. The criteria for their development were explained in the equivalent test for reading. Since in Spanish there is the possibility that the same phoneme can be written in more than one grapheme, and that the dictated words do not exist in the lexicon of this language, the patient's response will be considered correct whenever it corresponds phonologically to the dictated nonword.

Stimuli (n = 12)

1. *milen*
2. *ejus*
3. *reco*
4. *mayuma*
5. *transgo*
6. *chegafle*
7. *seidocu*
8. *lufeguay*
9. *fecelio*
10. *gropado*
11. *milogoti*
12. *frisculema*

4.2.5.9. Test N° 21: Dictation of words with graphic accent.

Words with graphic accent can be considered as irregular words, since their stress pattern is usually the marked pattern and this information is provided in the lexicon. A word that requires a graphic accent mark and is written without it is considered to be an orthographic fault.

Because this might be a difficult task, we chose only high frequency words.

Stimuli (n=18)

ANTEPENULTIMATE	PENULTIMATE	LAST SYLLABLE
1. *música* (40)	7. *ángel* (48)	13. *interés* (128)
2. *décimo* (263)	8. *débil* (24)	14. *común* (70)
3. *político* (149)	9. *útil* (24)	15. *emoción* (68)
4. *único* (126)	10. *egoísmo* (24)	16. *compás* (13)
5. *clásico* (57)	11. *fértil* (7)	17. *inglés* (62)

6. *ángulo* (40) 12. *lápiz* (6) 18. *ladrón* (25)

4.2.5.10. Test N° 22: Writing of homophonous words in context.

In order to evaluate the sequence from the SEMANTIC KNOWLEDGE to the LOGOGRAPHIC OUTPUT LEXICON (Figure 2, page 27), we have used a task based on Test D7 on Lecours' protocol that consists in giving the patient the definition or any semantic clue and asking him/her to write the word that corresponds to such a definition. Our variation consists in using words that have homophonous counterparts as a target, thus forcing even more the participation of the patient's orthographic knowledge.

Semantic clues may vary, but orthographic cues must never be given to the patient to facilitate his/her access to the word. The homophonous counterpart to the correct response follows the correct response in parentheses.

Stimuli (n=10):

1. *Lo que una hace con la basura.*

   BOTAR (votar)

2. *Lo que hace la modista con la aguja y el hilo.*

   COSER (cocer)

3. *Uno ralla el queso con un* _____.

   RALLO (rayo)

4. *Líquido que sale de una planta cuando le cortamos una rama.*

   SAVIA (sabia)

5. *Nombre del continente donde queda la China.*

   ASIA (hacia)

6. *Pelo suave de que recubre el cuerpo.*

   VELLO (bello)

7. *La comida de noche es la* _____.

   CENA (Sena)

8. *Conducto cilíndrico por donde pasa el agua.*

   TUBO (tuvo)

9. *La primera carta de la baraja.*

AS (haz)

10. *Original de Siria.*

SIRIO (cirio)

4.2.5.11. Test N° 23: Identification of syllables within words.

In order to evaluate the PHONOSYLLABIC INPUT REGISTER (**La**, Figure 2, page 27), the patient will be asked to circle or underline a syllable, given orally by the researcher, that he/she can find inside a word. The patient will receive the list of words, and he/she will listen to the syllable.

Stimuli (n=12):

WORD	SYLLABLE
1. *murciélago*	*la*
2. *ventana*	*na*
3. *elefante*	*fan*
4. *libreta*	*bre*
5. *centauro*	*cen*
6. *cangrejo*	*jo*
7. *humano*	*hu*
8. *ballena*	*lle*
9. *balcón*	*con*
10. *quiosco*	*quios*
11. *luciérnaga*	*na*
12. *genealógico*	*gi*

4.2.6. Analysis of results.

In order to facilitate the analyses of results of the tests and the classification of errors of reading and writing, the following tables were designed: Table 3 (pages 94-95) for the summary of the reading performance in the different tests according to the different kinds of stimulus, Table 4 (page 96) for the summary of the reading performance of the patient in each test, Table 5 (pages 97-98) for the summary of the writing performance of the patient in the different tests according to each kind of stimulus, and Table 6 (page 99) for the summary of the writing performance in each writing test. In these tables the number of stimuli per test is specified; this is to facilitate the calculation of the percentage of correct responses. On the other hand, Tables 7 and 8 (pages 100 and 101 respectively) were designed to facilitate the analyses of reading and writing errors of the patient.

Table 3: Summary of reading evaluation per test per type of stimulus

Test	n	RC	% RC
Test N° 1: Naming of letters (L6)	16		
Test N° 2: Discrimination of allographs (L9)	12		
Test N° 3: Reading aloud regular words			
Nouns			
Concrete-high frequency	12		
Concrete-low frequency	12		
Abstract-high frequency	12		
Abstract-low frequency	12		
Adjectives			
High frequency	12		
Low frequency	12		
Adverbs			
High frequency	12		
Low frequency	12		
Function words (L4)	24		
Verbs			
High frequency root-high frequency form	10		
High frequency root-low frequency form	10		
Low frequency root-high frequency form	10		
Low frequency root-low frequency form	10		
Morphologically complex words			
High frequency	12		
Low frequency	12		
Unknown frequency	12		
Compound words	20		
Short and long words (L18)			
High frequency short words	10		
High frequency long words	10		
Low frequency short words	10		
Low frequency long words	10		

Continues in next page

Test N° 4: Reading aloud irregular words	
Words of foreign origin (L1)	20
Words with erased graphic accent mark	
High frequency	30
Low frequency	30
Test N° 5: Reading aloud nonwords	
List 1: legitimate nonwords	20
List 2: visually similar nonwords	20
List 3: inverted nonwords	20
Test N° 6: Matching words with homophonous nonwords	14
Test N° 7: Discrimination of homophonous words in context	25
Test N° 8: Vocabulary comprehension	20
Test N° 9: Comprehension of paragraph	4
Test N° 10: Decomposition of words into syllables	
High frequency	12
Low frequency	12
Test N° 11: Decomposition of words into morphemes	
Transparent	20
Opaque	20
N/D	20
Test N° 12: Recognition of morphological relationship	
Legal pairs	24
Illegal pairs	24

Table 4: Summary of reading evaluation

Test	n	RC	% RC
Test N° 1: Naming of letters (L6)	16		
Test N° 2: Discrimination of allographs (L9)	12		
Test N° 3: Reading aloud regular words			
Nouns	48		
Adjectives	24		
Adverbs	24		
Function words (L4)	24		
Verbs	40		
Morphologically complex words	36		
Compound words	20		
Short and long words (L18)	40		
Test N° 4: Reading aloud irregular words			
Words of foreign origin (L1)	20		
Words with erased graphic accent mark	60		
Test N° 5: Reading aloud nonwords			
List 1: legitimate nonwords	20		
List 2: visually similar nonwords	20		
List 3: inverted nonwords	20		
Test N° 6: Matching words with homophonous nonwords	14		
Test N° 7: Discrimination of homophonous words in context	25		
Test N° 8: Vocabulary comprehension	20		
Test N° 9: Comprehension of paragraph	4		
Test N° 10: Decomposition of words into syllables	24		
Test N° 11: Decomposition of words into morphemes	60		
Test N° 12: Recognition of morphological relationship	48		

Table 5: Summary of writing evaluation per test per type of stimulus

Test	n	R.C.	% R.C.
Test N° 13: Spontaneous writing			
Name and signature			
Short paragraph			
Test N° 14: Copying of words (D15)			
Free copy	5		
From print to handwriting	5		
From handwriting to print	5		
Sentences	2		
Test N° 15: Copying of nonwords			
Legitimate nonwords	8		
Homophonous nonwords	8		
Test N° 16: Spelling of words			
First part: giving the letters	8		
Second part: giving the word	10		
Test N° 17: Dictation of letters	16		
Test N° 18: Dictation of syllables	10		
Test N° 19: Dictation of words			
Nouns			
High frequency-concrete-regular	6		
High frequency-concrete-irregular	6		
Low frequency-concrete-regular	6		
Low frequency-concrete-irregular	6		
High frequency-abstract-regular	6		
High frequency-abstract-irregular	6		
Low frequency-abstract-regular	6		
Low frequency-abstract-irregular	6		
Adjectives			
High frequency-regular	6		
High frequency-irregular	6		
Low frequency-regular	6		
Low frequency-irregular	6		

Continues in the next page

Adverbs	
High frequency-regular	6
High frequency-irregular	6
Low frequency-regular	6
Low frequency-irregular	6
Function words	
Regular	10
Irregular	10
Verbs	
High frequency-regular	6
High frequency-irregular	6
Low frequency-regular	6
Low frequency-irregular	6
Short forms of inflected verbs	
Regular	6
Irregular	6
Morphologically complex words	
High frequency-regular	6
High frequency-irregular	6
Low frequency-regular	6
Low frequency-irregular	6
Control words	6
Compound words	
Regular	6
Irregular	6
Short and long words	
Short	6
Long	6
Test N° 20: Dictation of legitimate nonwords	12
Test N° 21: Dictation of words with graphic accents	18
Test N° 22: Writing of homophonous words in context	10
Test N° 23: Identification of syllables within words	12

Table 6: Summary of writing evaluation

Test	n	R.C.	%R.C.
Test N° 13: Spontaneous writing			
Name and signature			
Short paragraph			
Test N° 14: Copying of words (D15)			
Free copy	5		
From print to handwriting	5		
From handwriting to print	5		
Sentences	2		
Test N° 15: Copying of nonwords			
Legitimate nonwords	8		
Homophonous nonwords	8		
Test N° 16: Spelling of words			
First part: giving the letters	8		
Second part: giving the word	10		
Test N° 17: Dictation of letters	16		
Test N° 18: Dictation of syllables	10		
Test N° 19: Dictation of words			
Nouns	48		
Adjectives	24		
Adverbs	24		
Function words	20		
Verbs	36		
Morphologically complex words	30		
Compound words	12		
Short words	6		
Long words	6		
Test N° 20: Dictation of legitimate nonwords	12		
Test N° 21: Dictation of words with graphic accents	18		
Test N° 22: Writing of homophonous words in context	10		
Test N° 23: Identification of syllables within words	12		

Table 7: Summary of reading errors

Type of error	Examples	n	%
Phonemic paralexia			
Lexical/visual paralexia			
Semantic paralexia			
Circumlocution			
Lexical paralexia			
Morphological paralexia			
Visual then semantic paralexia			
Neologism			
Omissions			
Perseverance			
Lexicalizations[21]			
Regularizations[22]			

Table 8: Summary of writing errors

[21] Only possible in the reading of nonwords.
[22] Only possible in the reading of irregular words.

Type of error	Examples	n	%
Phonemic paragraphias			
Lexical/visual paragraphias			
Semantic paragraphias			
Circumlocution			
Lexical paragraphias			
Morphological paragraphias			
Visual then semantic paragraphias			
Neologism			
Omissions			
Perseverance			
Lexicalizations[23]			
Regularizations[24]			

[23] Only possible in the writing of nonwords.
[24] Only possible in the writing of irregular words.

Chapter 5:

The Assessment of Surface Dyslexia in a Regular {PRIVADO } Orthography, Spanish: A Case Study.

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ABSTRACT

The main characteristic of surface dyslexia is the production of regularization errors when reading aloud irregularly spelled words. The testing for this dyslexic syndrome in Spanish where correspondence from grapheme-to-phoneme is regular can be problematic. Taking advantage of the highly lexicalized stress pattern in this language, a test was designed to assess reading regularization errors. Other manifestations of SD such as homophone confusion, frequency, word category, and imagibility effects were studied. We report a case of acquired dyslexia and dysgraphia in a unilingual Spanish speaker showing all the symptoms of surface dyslexia as described for opaque orthographies.

Introduction.

In the controversy surrounding Ardila's claim that the three dyslexic syndromes - surface, deep, and phonological dyslexia - described for opaque orthographies (Marshall & Newcombe, 1966, 1973; Beauvois & Dérousné, 1979) should not be observed in Spanish, reports on surface dyslexia in this language has been left out. Due to its transparent orthography, it is assumed that Spanish readers

will invariably use the grapheme-to-phoneme conversion, a paralexical route for reading this language is excluded (Ardila, 1991; Ardila, Rosselli, & Pinzón, 1989). We will discuss here neither deep nor phonological dyslexias (Ruiz, Ansaldo & Lecours,1994; Ferreres & Miravalles, 1995). Our main concern here is the manifestation and evaluation of surface dyslexia in Spanish, a language with no irregularity at reading, but irregularity at writing.

The main characteristics of surface dyslexia are: regular words are read better than irregular words; pronunciation of an irregularly written word usually is an incorrect but phonological rendering of the target word; confusion of homophones is high. Comprehension is of the given oral response and not of the written word; legal non-words are read accurately; and variables such as frequency, imagibility, word category, and word length usually do not affect reading performance (Patterson, Marshall & Colheart, 1985).

Our question was then how to evaluate surface dyslexia where there is no irregularity in the orthography. To test comprehension alone is problematic, since these patients tend to repeat aloud to themselves the target word until they understand it. To test the production of regularization errors in reading aloud, we designed a test that takes advantage of the highly lexicalized stress pattern of Spanish words (Harris, 1983). Writing to dictation regular and irregular words was also tested.

CASE REPORT

Mr.ITA is a 67 year old, right-handed, unilingual Spanish- speaking retired medical doctor. In September 1986 he had a CVA with loss of consciousness, right lower limb paresis, right-side loss of strength, difficulties with speech and writing. He was hospitalized for 15 days, a thrombosis was diagnosed. 8 months later he was operated on. A CT scan revealed an old infarction in the left temporo-parietal region, a more recent infarcted zone in the left anterior inferior temporal region, another infarction in the posterior temporo-parietal area, a non severe lesion in the ventricular region, along with non severe bilateral subcortical damage.

Neurological examination

Mr.ITA motor functions have been recovered. His hearing is normal for his age. He wears eyeglasses. His color vision is normal. In an informal visual-field test, he showed right homonymous hemianopsia. His visual recognition of objects is intact. His calculation abilities are impaired. He presents no agnosias. Neither buco-facial, ideomotor, nor ideational apraxia are present; however, a constructional apraxia was detected (Rey-Osterrieth Complex Figure Test). His attention is normal ("A" Cancellation Test). His speech is fluent but anomic (BDAE for Spanish, Ardila, Rosselli, & Puente, 1994). His repetition is impaired, particularly for non-words and long sentences (our own test).

Reading aloud words and non-words:

The patient read 148 words (48 nouns, 20 adjectives, 20 adverbs, 20 function words, and 40 verbs) with no mistakes. Frequency and imagibility were controlled. 20 legal non-words were read correctly.

Reading aloud words with erased accents:

In Spanish, stress in lexical categories other than verbs cannot be determined solely on syllabification and/or morphological composition. Generally, penultimate stress on vowel-final words and final stress in consonantal final-words is unmarked . Marked stress is lexicalized (Harris, 1983). In writing, all marked stress is signaled by a graphic accent (') . A list of 30 words with marked stress (ultimate, penultimate, and antepenultimate) where graphic accents had been erased was prepared. If a patient reads such words by grapheme-to-phoneme conversion only, he will give the unmarked stress pattern. Lexicalization would be needed to give correct stress pattern.

Mr.ITA committed 12 stress pattern regularization errors; i.e., he gave the unmarked stress pattern. e.g. corazon -> corázon (correct: corazón = heart); aqui -> áqui (correct aquí = here). Word frequency had no effect.

Recognition of homophones:

Mr.ITA was asked to fill in the blank in a sentence with one of a pair of homophones (n=20). Correct answer position was balanced. This test was administered twice with six-months interval. In the first trial, Mr.ITA answered 46% correctly, and in the second trial, 65%.

Reading comprehension:

In a multiple choice question test (n=20), Mr.ITA answered 95% correctly, but he vocalized choices before answering.

Writing to dictation:

80 words were dictated (40 regular and 40 irregular). Word category and frequency were controlled. 31 out of 40 irregular words were misspelled, and only 2 regular words. 24 were regularization errors (e.g.,pescado -> pezcado; cuyo -> cullo, también -> tanbien). No lexicalization was observed.

DISCUSSION

Mr.ITA presents the symptoms of surface dyslexia. He made regularization errors in reading aloud words with erased graphic accents, and presented a high confusion with homophones. Given the transparency of the Spanish orthography, it is not surprising that he read aloud correctly all real and non-words. He showed no frequency, imagibility, or word category effects. In writing, he made a large number of regularization errors and lexical paralexias were not observed.

The syndromes described for English and French can be also relevant for Spanish. It is true that without the design of special tests to force lexicalization, the observation of regularization errors when reading Spanish aloud , central to surface dyslexia, seems impossible. However, the difficulty of the testing does not preclude the existence of the problem.

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Chapter 6:

Lexical reading in Spanish: Two cases of phonological dyslexia.

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Short title: Phonological dyslexia in Spanish.

Abstract

The way spoken language is represented by orthographic structure is thought to influence cognitive reading mechanisms for each language, and therefore, language breakdown patterns should reflect this. Two patients, monolingual native Spanish speakers, who were able to read words but showed great difficulty in reading non words, are described in this paper. Our findings could be accounted for if we assume that these patients are reading globally using a lexical route. This pattern of reading behavior is known as phonological dyslexia. It has been argued that lexical reading is not an option for Spanish readers since its orthography is highly regular. Our results contradict this hypothesis and support the view that cognitive reading mechanisms are universal.

Introduction

The study of reading behavior of dyslexic patients has been a valuable source of information concerning the sub-processes involved in normal reading. That reading can be selectively impaired is the strongest evidence in favor of the idea that it is not

a unitary process but is the result of a collection of sub-processes working concurrently.

The three dyslexic syndromes characterized in the literature -- surface, deep, and phonological dyslexia -- are far more complex than originally thought; however, their description and conceptualization have been very fruitful in providing the hypotheses and models against which new observations can be probed and new models developed. On these grounds, several dual-route models of reading have been developed with different degrees of specificity (Newcombe & Marshall, 1986; Morton & Patterson, 1986; Coltheart, 1981; Marshall, 1987; Patterson, Marshall & Coltheart, 1985; Lecours, 1996). According to these models there are at least two routes by which a word can be read: (1) An analytical route, from the visuo-perceptual level to the phonological level, and (2) a global route, from the visual level to the lexical or semantic level (Beauvois & Dérouesné, 1979). The first route is also known as the phonological assembly route, and the second as the lexical access route (Patterson,1982). That is, a written word can be read at the lexical or, if it is regular, at the sub-lexical level (Marshall & Newcombe, 1973; Shallice & Warrington, 1975; Patterson & Marcel, 1977; Saffran & Marin, 1977).

Nevertheless, most word recognition models have been developed for languages like English and French where the grapheme-to-phoneme correspondence is not always regular, demanding some degree of lexicalization on the part of the reader in order for him/her to access the correct pronunciation of words. One question that has been puzzling researchers for some time is to what extent the way spoken language is represented by printed symbols in different languages will determine or affect the way reading is acquired and executed by expert readers; that is, whether some orthographies will favor one or the other reading route (Hung & Tzeng, 1981; Henderson, 1982; Paradis, Hagiwara, & Hildebrandt, 1985; Yin & Butterworth, 1992; Lecours, 1996). This view has given rise to the so-called Orthography Depth Hypothesis (ODH) which states that shallow orthographies, where the letter-to-phoneme correspondence is very consistent, support a word

recognition process through phonological mediation more easily, i.e. the phonological route, whereas deep orthographies, where the letter-to-phoneme correspondence depends on context, encourage a reader to access the morphology of the word through its visual structure, i.e. through the lexical route (Liberman,et al., 1980; Katz & Feldman, 1983; Katz & Frost, 1992).

It has been argued by Ardila and colleagues (Ardila, Rosselli, & Pinzón, 1989; Ardila, 1991) that lexical reading is not an option for Spanish readers since this language has a transparent orthography. According to their view, reading in Spanish always entails a phonologically mediated route. These researchers base their claim on three observations: first, the transparency of the Spanish orthography; i.e., each grapheme always corresponds to one phoneme, yet in some cases the same phoneme can be represented by more than one grapheme; second, in the patients they had observed there is more or less a similar degree of impairment when reading different types of words; third, in their clinical research they have not observed the production of semantic paralexias in any of their patients (however, see Ruiz, Ansaldo, & Lecours, 1994; and Ferreres & Miravalles, 1995). According to Ardila, "Reading in English and reading in Spanish are undoubtedly two different cognitive tasks ... Psychological models of reading should be adapted and reconsidered in the light of different writing systems" (Ardila, 1991, p.444). Ardila, Rosselli, and Pinzón (1989, p. 173) claim that "for Spanish the underlying cognitive operation during reading is to convert graphemes into phonemes." Moreover, they maintain that reading and writing disorders observed in patients with brain lesions are determined by the language of the speaker and not by any intrinsic aspect of the cognitive system. These researchers seem to support the strongest version of the Depth of Orthography Hypothesis which denies that the normal brain ever develops associations between global orthographic patterns and semantics in scripts where spelling to sound correspondence is highly regular (Bridgeman, 1987; Turvey et al., 1984). Cuetos, Valle-Arroyo, and Suarez (1996) reported one case of phonological dyslexia in Spanish showing a dissociation of reading words versus non words

similar to that found for opaque orthographies. These authors argue that this particular patient seems to have been reading lexically due to problems with the blending stage of reading -- that is, with the integration of the phonological units into a whole phonological form -- rather than with other aspects of the non-lexical route of reading.

In this article we will describe two clear cases of phonological dyslexia in Spanish with a marked difference when reading words versus non words. We will argue that this is possible only if these patients are reading via the lexical route and challenge the claim of Ardila and colleagues that lexical reading is not an option in Spanish. We will discuss our findings in terms of certain linguistic aspects of Spanish orthography that permit lexicalization, the universality of cognitive processes in reading, and level of reading skills. We will also reexamine the Depth of Orthography Hypothesis with respect to Spanish. Our testing protocol for Spanish was based mainly on Lecours' model for French (1996) since this is a highly specified model with respect to the possible sub-components in the lexical as well as the sub-lexical routes (See Figure 1)

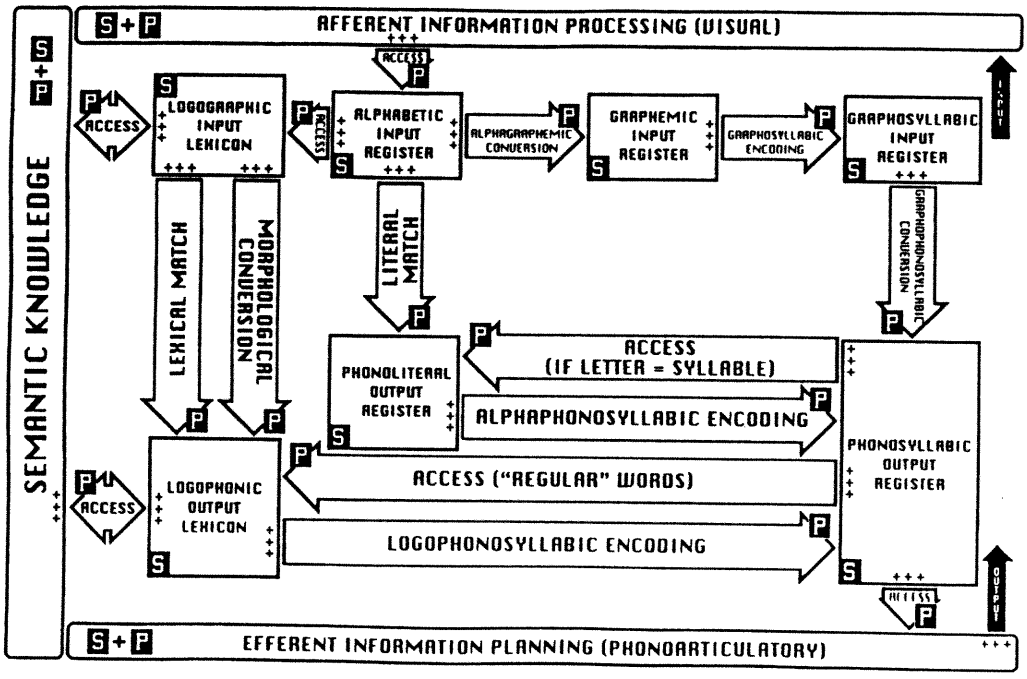

Figure 1. Reading aloud (words, locutions, phonologically legitimate non-words).

Phonological dyslexia:

Phonological dyslexia has been described as a selective disturbance of reading with more or less preserved oral expression and comprehension, a disturbance of the phonological reading process and not of the non phonological or lexical reading process, and a disturbance at the phonological stage of reading and not at the perceptual or expressive stage of reading. The core symptom seems to be, though, the relative preservation of the ability to read words in contrast with a marked inability to read non words. Most reading errors in these patients tend to be visual confusions and derivational mistakes. Unlike deep dyslexics, these patients make almost no semantic paralexias, and word orthographic regularity, word category, word frequency, imagibility and length, may or may not affect their reading (Beauvois & Dérouesné, 1979; Patterson, 1982; Beauvois, Dérouesné, & Saillant, 1980; Funnell, 1983; Job & Sartori, 1984). In a review of 16 cases of the syndrome, Sartori, Barry and Job (1984) observed that there is no apparent relationship between type of aphasia and phonological dyslexia, that there is a great deal of variation between patients' word and non word reading performance, and that lesion site varies from patient to patient. In reading words, these patients made mostly derivational and visual errors similar to the target, nouns were read better than verbs, and there was no concreteness effect; and in non word reading there were few omissions, some lexicalizations, and the patients produced other visually similar non words. Goodall and Phillips (1995) report a 7-year study of a phonological dyslexic patient who learned to read some non words only when such non words were paired with drawings of nonsense objects but her reading of other non words never improved.

Dérouesné and Beauvois (1979) found a double dissociation between two patients and suggested that phonological dyslexia could arise due to either problems with the graphemic processing or with the phonemic processing. In Lecours' model (1996) the former corresponds to the graphosyllabic encoding process (G5) and the latter, to the graphophonosyllabic encoding process (B12). In another study,

Friedman et al., (1993) report a case of a patient who showed a pattern of phonological dyslexia when reading words presented visually, but not when words were spelled aloud to him. They claim that this might be a case of a modality-specific phonological dyslexia.

Whether deep and phonological dyslexia are viewed as two distinct disorders, the former as a reflection of right hemisphere reading due to left hemisphere impairment, and the latter as a reading problem mediated by an impaired left hemisphere (Coltheart, 1983; Saffran et al., 1986), or whether deep dyslexia is a variant of phonological dyslexia (Glosser & Friedman, 1990) will not be developed here. What concerns us is the fact that both syndromes can be explained in terms of damage to the phonological route of reading with more or less preserved lexical processing. The observation of phonological dyslexia is evidence that a lexical route is employed when reading.

CASE REPORTS

Case 1:

TRP is a native monolingual Spanish speaker. She is 66 years old, and right-handed. She finished three years of high school, and worked for 18 years as a secretary in a civil court. The patient reports no learning difficulties during school years. At the time of the testing, she was retired. In August 1993, TRP suffered a left-hemisphere CVA in central middle artery, with right-body hemiparesis and expressive aphasia. She was hospitalized for 7 days. An EEG test revealed activity in the left hemisphere with altered organization. There was a problem of reactivity and lack of energy. The patient has diabetes and is a heavy smoker.

Neuropsychological examination:

TRP wears eyeglasses, but upon confrontation she does not seem to have any visual field defect. Her hearing is intact according to an audiological examination. In a task matching drawings to words and sentences, her recognition of objects was perfect. She presents a mild acalculia but none of the agnosias and none of the apraxias, including constructional apraxia (Rey-Osterrieth Figure Test). Her attention is

normal ("A" Cancellation test). Her verbal memory is normal for her age and education according to a verbal serial learning curve (Ardila, Rosselli, & Puente, 1995). At the time of our interviews, TRP had recovered completely from any motor impediment, and she was very talkative and sociable.

With respect to her language, TRP mainly demonstrates a word-finding difficulty, i.e. anomia (BDAE adaptations for Spanish by García-Albea & Sanchez-Bernardos, 1986). Except for her anomia, her speech can be considered fluid, with a good voice quality and intonation. She produces no phonemic paraphrasias when speaking, and her oral comprehension is intact. In a Verbal Fluency Test she scored below normal for her age and education (Ardila, Rosselli, & Puente, 1995). She was able to recall semantic categories better than words starting with certain sounds. Her repetition, according to our own test, was intact for syllables, words and short sentences, but it was impaired for non words and long sentences. Her reading will be discussed in detail later; however, it should be noted that the most outstanding symptom is her inability to read non words in contrast with her much better performance on real words. Her writing will be discussed elsewhere. Although her handwriting is good, she has dysgraphia, making non related lexical substitutions when writing spontaneously and writing to dictation.

Case 2:

CPG is a 42-year-old man, left-handed, and native Spanish speaker, descendant of Portuguese. He is a sociologist and was a university professor until his last CVA. Suddenly on the morning of Dec. 28, 1994, he became disoriented and his language became reduced and dysarthric. He presented generalized weakening, right hemiparesis, he became somnolent and later lost consciousness. The next day he was hospitalized for 16 days. An embolic CVA and a left hemiplegia were diagnosed. Before this accident, CPG had three epileptic attacks (two partial seizures and a generalized seizure), he suffers from a heart condition and high blood pressure. A CT scan without contrastive substances, performed three days after the stroke, reveals neither infarcted areas nor any hemorrhage.

Neuropsychological examination:

CPG has right homonymous hemianopsia, and his eyesight tends to the left. Other eyes reflexes are intact. Hearing is also preserved. At the time of our interview, the patient still presented right side hemiparesis, in particular of the arm, and used a cane to walk. He had some behavioral problems; at times he was overly friendly, speaking very loudly, and at other times, he was depressive and showed some perseverations. His recognition of objects was preserved, as well as the recognition of sick side and illness. However, he presented right digitoagnosia. He did not have any apraxia. His copy of the Rey-Osterrieth Figure was accurate and well proportioned. His comprehension was preserved for simple and complex commands. Attention was normal according to the "A" Cancellation Test. His verbal memory was normal for his age and education according to a verbal serial learning curve (Ardila, Rosselli, & Puente, 1995).

According to the BDAE (adapted for Spanish by García-Albea & Sanchez-Bernardos, 1986), CPG is a non-fluent Broca's aphasic. He has great difficulty articulating speech. He speaks in short outbursts, and sometimes writes his answers on the table, particularly numbers such as date of birth, age, etc. He has great difficulty finding words. He speaks fast and loudly. The grammatical complexity of his sentences is limited and he uses some stereotypical expressions. He makes very few phonemic paraphrasias. He was able to repeat high frequency short words and short sentences; however, he had great difficulty repeating low frequency words, syllables, non words, and sentences longer than four words. In the last case, he would give a shorter ungrammatical semantic equivalent. He shows a phonological dyslexic pattern; his reading behavior will be described in detail later. Due to his right arm paresis, his writing is very limited and could not be tested in depth; yet he was able to copy a few words, but his spontaneous writing and his writing to dictation is severely impaired even with his left hand.

Reading evaluation:

Letter identification: Results of these tests are shown in Table 1.

Naming of letters (L6)[1]: Patients were asked to read aloud 16 letters, some with one syllable names like [a] and [p], others with longer names like [y]-> "i griega", and double character letters like [ch]. Lecours (1996) states that the name of letters are similar to the name of other entities and that they are the object of particular learning.

TRP was able to give 12 (75%) correct responses, her errors were basically that in the place of the name of the letter she would give a word starting with the same sound, e.g. [z]-> "zapato" (shoe), [p]-> "pipa" (pipe), and there was one omission [ñ]-> "no sé" (Don't know). CPG was not able to give any response. He looked at the cards for a long time and then refused to continue.

Allographs discrimination (L9): This test was designed to see if the patients had problems with visual letter recognition or what Lecours (1996) calls the "alphabetic input register." In a series of four letters in different types and styles, the patient is asked to point to the letter that does not belong to the series. Six series were developed for visual similarity and six for phonological similarity. There are 3 quadruplets for training and 12 for testing. Each quadruplet was printed on a separate card, and each card was shown separately to the patient. TRP as well as CPG scored perfectly on this test showing that they did not have any problem with visual letter recognition.

	Patient TRP	Patient CPG
Letter Identification		
Naming of letter (n=16)	12 (75%)	0
Allograph discrimination (n=12)	12 (100%)	12 (100%)

TABLE 1: *Number and percentages of correct responses in the letter identification tests.*

Reading aloud of regular words

In the following tests, patients were asked to read aloud words presented in isolation written on cards. The words were drawn from different grammatical categories. Frequency was controlled for each category. Frequency indexes were taken from Juilland and Chang-Rodriguez (1964) made for Spanish from Spain, but care was taken to include only words that were considered by independent judges to be the preferred form in Venezuelan Spanish.

	Patient TRP	Patient CPG
Reading aloud regular words		
Nouns (n=48)	46 (96%)	43 (90%)
Function words (n=20)	20 (100%)	14 (70%)
Adjectives (n=24)	21 (88%)	22 (92%)
Adverbs (n=24)	20 (83%)	18 (75%)
Verbs (n=40)	22 (55%)	8 (20%)
Short words (n=20)		18 (90%)
Long Words (n=20)		9 (45%)
Compound words (n=20)	17 (85%)	9 (45%)
Reading aloud irregular words		
Words with erased graphic accent (n=30)	25 (83%)	24 (81%)
Words of foreign origin	9/13 (69%)	4/18 (22%)

TABLE 2: *Number and percentages of correct responses in reading aloud regular and irregular words.*

As shown in table 2, in both cases we observed a word category effect. TRP read function words best (100%), followed by nouns (90%), adjectives (88%), adverbs (83%), and lastly verbs (55%). CPG read adjectives best (92%), followed by nouns (90%), adverbs (83%), function words (70%) and lastly verbs (20%). Both patients read nouns and adjectives better than verbs. There was a general tendency to read high-frequency words better than low-frequency words but in most cases, this did not reach any level of significance.

With respect to nouns, although most errors were committed with abstract words, according to a Chi-square test, neither frequency nor imagibility effect reached any level of significance (X^2=.164, n.s. for TRP and X^2=.205 n.s. for CPG).

In testing the reading of verbs, Lecours (1996) examined the contrast of reading infinitives versus inflected forms (Test L5). In our test we have chosen to test root frequency versus inflection frequency since in Spanish infinitives most often tend to be low-frequency verb forms. We prepared a list of 40 verbs in the following manner: 10 high-frequency roots with their most frequent inflected variant, 10 high-frequency roots with their least frequent inflected variant, 10 low-frequency roots with their most frequent inflected variant, 10 low-frequency roots with their least frequent inflected variant. Both patients had great difficulty with inflections when reading verbs. High-frequency roots with high-frequency variants were the easiest to read; however, X^2 tests did not reach any level of significance for either patient.

Kremin (1985) argues that, for surface dyslexics, word length should not produce any effect since these patients read only by grapheme-to-phoneme correspondence from left to right regardless of word structure; hence it is assumed that if word length has any effect on the reading of patients, it is because some degree of lexicalization or global reading is taking place. TRP read 100% of short words but only 13 out of 20 long words (65%). However, this difference did not reach any level of significance (X^2 = 2.125, n.s.). On the other hand, CPG read 18 (75%) short words but only 9 (45%) long words correctly. In CPG's case, X^2 =

5.625, this difference is significant at the $p < .02$ level.

Reading aloud irregular words.

In Spanish each grapheme always corresponds to the same phoneme; therefore, it is almost impossible to say whether a person reading aloud does it through the lexical or sublexical route, since in both cases the output will be the same. Based on the highly lexicalized rules of stress in Spanish and on the borrowing of foreign words into the language we designed two tests to introduce irregularity elements into reading aloud. It is predicted that if these words are read with their correct "irregular" pronunciation it is because they are being read via the lexical route, whereas if they are given an incorrect but regular reading it is because they are being read via the sublexical route. Results are shown in Table 2.

Reading of words with missing graphic accents: In Spanish the stress pattern for words other than verbs is highly irregular. This information must be supplied in the lexicon. Generally, penultimate stress is unmarked in vowel final words, and final stress is unmarked in consonantal final words; however, this characterization is not sufficient to determine word stress (Harris, 1983). In order to keep the orthographic representation as close to the pronunciation as possible, in cases where stress patterns do not follow the rule mentioned above, the tonic stress is graphically marked. Hence, we encounter words like "pistola" (unmarked) and "epístola" (marked). If we erase the graphic accent from marked stress words, the only way that these words can be read correctly is if they are lexicalized. In other words, we introduce an irregularity element. The prediction is that for patients who are able to lexicalize, the correct pronunciation of such words should be possible. By contrast, for patients who are not able to lexicalize, they will be expected to regularize the stress of such words giving an incorrect reading (see Iribarren, Jarema, & Lecours, 1996)

In this task subjects will be asked to read aloud 30 words whose graphic accents have been erased, 10 with antepenultimate stress ("esdrújulas"), 10 with penultimate stress ("llanas"), and 10 with final stress ("agudas"). Care was taken not to include words that change meaning according to stress pattern; for example,

"público" (public), "publico" (I publish) and "publicó" (he/she published). For this purpose, word selection was compared to the list of such triplets of words given in Huertas-García (1974). Words were presented in isolation on separate cards and given to the patient randomly.

TRP read 25 words correctly (83%), however, she did not make any regularization errors. CPG read 24 items correctly (80%); he also did not commit any regularization errors.

Reading words of foreign origin: A list of 20 words of foreign origin commonly found in writing in Spanish were selected from Huertas-García (1974) and Faitelson-Weiser (1987). Frequencies are not known because, although words of foreign origin can be found in Spanish dictionaries[2], they are excluded systematically from any statistical study of Spanish. However, care was taken to select those that are not considered either highly technical or uncommon. The prevaling criteria was that these words do not obey the grapheme-to-phoneme correspondence mapping for regular Spanish words. For example, a word like "boy" was excluded because it can be read correctly as a non word by regular Spanish grapheme-to-phoneme mapping. The only way to read aloud these words correctly is to have them lexicalized.

TRP read 9 out of 13 words correctly (69%) and then she refused to continue. CPG read 4 out of 18 items correctly (22%). In both cases, patients gave signs of understanding the meaning of the words, and they produced almost no regularization errors.

Type of errors when reading words:

In Table 3 there is a summary of the type and number of errors committed by each patient when reading words. In both patients we observe the same general tendencies: the number of morphological errors is high in comparison with other type of errors; visual confusions producing either another word (visual/lexical paralexia) or a non existent form (neologism) are frequent too, and phonemic errors, omissions, and regularizations are rare.

Type of error	Patient TRP	Patient CPG
Semantic paralexias	3	9
Morphological errors	25	48
Visual/lexical paralexias	9	15
Neologisms		
Visual	9	2
Non visual	3	17
Phonemic errors		
Paralexias	none	7
Anticipations	none	2
Perseverations	none	1
Omissions	3	3
Regularizations	2	none

TABLE 3: *Number and type of errors when reading words.*

Morphological errors were particularly evident in reading verbs. In this test alone TRP made 17 morphological errors, 13 of which involved giving the wrong inflection, e.g., [razonan] --> "razóname" (trans., "they reason" -> "you explain that to me"), and in four cases she changed the root but kept the inflection, e.g., [golpearse] -> "copearse" (trans., "to hit oneself" -> "to copy something"). In reading

verbs, CPG made 21 morphological errors, and in every case these involved the inflection, e.g., [olviden] -> "olvidar" (trans., "that they forgot" -> "to forget"). However, in the other tests they made many errors involving derivational affixes (e.g., CPG in reading nouns, [pereza] -> "perezoso" , trans., "lazyness" -> "lazy").

There were a few semantic paralexias, patient CPG made 9 and patient TRP made 3 particularly when reading irregular words (i.e., words of foreign origin). Examples of semantic paralexias are: for CPG [escuela] -> "colegio" (school -> college), and [representación] -> "otro por mí" (trans.,"representation" -> "another in my place"); and for TRP, when reading words of foreign origin, [nylon] -> "medias" (trans., 'stockings').

As examples of visual/lexical paralexias we can cite TRP reading "lazaña" (lasagne) instead of target word [hazaña] (feat), and CPG reading "clínico" (clinical) instead of target word [cínico] (cynical). Sometimes visual confusions produced neologism, e.g., [manifestación] -> "marifestación" (demonstration -> ?), from TRP; and [estrechas] -> "estraches" (you narrow something -> ?), from CPG.

Non visual neologisms were those productions that have nothing to do with target, e.g., [llamara] -> "dicurara" (that he would call -> ?), from TRP, and [siguiendo] -> "quetables" (following -> ?), from CPG.

TRP did not commit any error that could be classified as phonological. CPG made few phonological errors; for example, two anticipations: [casualidad] -> "causualidad", and [patria] -> "pratria"; and one perseveration: [pero] -> "perro, perra, no, una erre nada más, perro" (trans, "but" -> "dog, bitch, no, with one "r" only, dog"; and some phonological paralexias, e.g., [enseguida] -> "anseguida".

In reading foreign words, CPG produced the irregular pronunciation correctly in eight instances, but he attached to them what he considered a foreign sounding ending; e.g., [nylon]->/nailonks/, [baby]->/baibiks/. TRP made two regularization errors when reading words of foreign origin; e.g., [seven up] -> /seben up/. There were very few omissions, 3 for each patient.

Reading of non words.

One indication that a patient might be using a lexical approach when reading is his/her inability to read non words. Since non words do not possess any semantic content, and since we do not expect to find in the mental lexicon of the patient any visual form corresponding to them -- though there might be visually and phonologically similar forms permitting some degree of reading by analogy -- the only way to access the correct pronunciation of non words will have to be by an analytical grapheme-to-phoneme route. For this reason, it has been assumed that the incompetence in reading non words in contrast with a much better performance in reading words is a sign of difficulties with the sublexical route for reading. Dérouesné and Beauvois (1979) discuss the possibility that this difficulty in the non lexical route of reading can arise at different levels of the process; they found a double dissociation in two patients -- one showing difficulties at the phonological level and another at the graphological level. Given the particular orthographic structure of Spanish, we sometimes translated Lecours' tests and sometimes designed our own tests, to try to localize the specific problem at the functional level. Results are shown in Table 4.

	Patient TRP	Patient CPG
Reading of non words		
- Reading aloud legitimate non words (n=20)	4 (20%)	0
- Reading pseudowords (n=20)	12 (60%)	0
- Reading inverted words (n=20)	7 (35%)	0
-Pairing words with homophonous non words (n=12)	11 (92%)	12 (100%)

TABLE 4: *Number and percentages of correct responses in reading non words.*

Reading aloud legitimate non words (L3): We consider a non word a string of letters that respects the syllabic structure of the Spanish language but which has no resemblance to any existing Spanish word; that is, it lacks any form of semantic content. In order to avoid the lexical effect in non word reading found for Spanish for pseudowords as reported in Sebastián-Gallés (1991), a list of 100 non words was prepared and a group of 5 native Venezuelan Spanish speakers were asked to judge them with respect to real word similarity. Sixty-seven words were judged to be very dissimilar to real words. From these, 20 were chosen for this task.

In a first trial, TRP was able to read 3 out of 12 words (25%) and then she refused to continue. Among her incorrect answers, she made 3 lexicalizations, e.g., [maferi]->"familia"; 6 partial lexicalizations were made (i.e., when part of her response corresponded to a real word), as [cahomite]->"cafenime"-(coffee-nime) or [betelimu]->"defelino" (de-feline); and one visual or perhaps phonological error, [buquire]->"fuquire". In a second trial, she read 4 out of 20 non words correctly (20%). It is worth mentioning that the same set of non words was used in the second trial as well, with an interval of one month between trials. Her correct responses corresponded to two-syllable words. She made 12 visual/phonological paralexias, e.g., [trovoni]->"troponi", and in 4 of these, she showed approximation reading behavior: e.g., [hestrala]-> "etrapa, etrale, estrela". There was one lexicalization, [brecolla]-> "precoz". Basically she substituted the non words with other orthographically similar non words. Throughout the whole test she was not satisfied with her responses, and she said that it was "extraterrestrial language".

On the other hand, CPG was unable to read aloud any non words correctly. He said it was German and gave 20 foreign-sounding responses that were jargon non words unrelated to target.

Reading pseudowords and inverted words: Beauvois and Dérouesné (1979) designed two tests in order to establish whether their patients were reading globally or analytically. In the first, patients were given words written in confusing

handwriting and in the second they were given words written in reverse order. The first test would require a global method of reading and the second, an analytic approach. In a similar manner, we designed two tests using non words to test whether our patients were using a global or analytical reading strategy. In the first one, we prepared a set of 20 non words constructed by changing one vowel from a high-frequency noun while trying to preserve the general visual configuration of the original word. In the second, 20 non words were created reversing the order of syllables of the same high-frequency nouns used in the first set. Reversing the order of letters was not used because, in some cases, it would produce unacceptable syllables in Spanish. In this manner, visual similarity with real words was lost but we could test grapheme-to-phoneme correspondence when syllable structure was kept constant. For example, from the word [pintura] we had the pseudo word [pentura] and the reversed non word [ratupin].

Words from the two lists were randomized and presented in isolation. Patients were asked to read as many as they could and try hard even if it was difficult for them.

TRP read 7 out of 20 inverted words correctly and 12 out of 20 pseudowords correctly. When reading pseudowords she made 4 restitutions, i.e., she read the original word rather than the target word ([balcún] -> "balcón") and one visual/lexical paralexia ([espulda] (from 'espalda') -> "expulsa"). The rest of her mistakes in both types of words were phonological/visual approximations to target, e.g., [fuigo] -> "luigo".

CPG was not able to read any target word correctly from either type of words. With respect to pseudowords, he produced 13 restitution errors (e.g., [muntaña]->"montaña"), in one of these he made 1 restitution plus a morphological error ([ministurio]->"ministro"), 3 visual/lexical errors ([tallor], from [taller]-> "tallo" (stem)), and 1 unclassified error ([calegio] from [colegio]-> "una flor" (a flower). With respect to the inverted words, he produced 11 restitutions ([gofue]->"fuego" (fire)), 5 visual/lexical errors ([dapales] from [espalda]-> "pañales"

(diaper), and 4 omissions.

Pairing words with homophonous non words: Following Lecours (1996), in order to test whether the problem is at the level of graphonosyllabic conversion or later, we designed a test in which the patient was asked to match a real word with one of two non words, one of which is a homophone to the word (correct response), and another non word which visually resembles the homophone. In this case, phonology is preserved, but care was taken to make the non words as visually dissimilar as possible. Thus, in order to read correctly the patient has to convert the graphosyllabic form into a phonological form, e.g. [hueco]: uevo -- ueko. Fourteen sets were prepared, the first two were used for explanation and training and the twelve remaining sets were uses for the test itself.

TRP matched 11 items correctly (92%) and CPG matched all of them (100%) correctly, hence in both cases, we can infer that their the grapho-phonological conversion might be intact.

Orthographic knowledge

15. Spelling: This test has two parts. In the first, words are spelled to the patient, and in the second the patient is expected to spell out a word that has been read aloud to him/her. In this way, considering that in Spanish sometimes the same phoneme can be spelled with a different letter, the logographic lexical memory as well as alphabetic memory can be tested. In both cases words were presented in increasing order of length. Results are shown in Table 5.

a. In this test 10 words were spelled to the patient one by one, and immediately after, the patient was required to say the word aloud. TRP was not able to do even one item correctly. CPG was able to give 2 correct responses corresponding to words with less than 4 letters.

b. In the second part of the test, the patient was given a word and was asked to spell it out. TRP, again, was not able to give any correct answer. CPG was unable to say the letters aloud, but he traced them on the desk with his finger.

	Patient TRP	Patient CPG
Orthographic knowledge tasks		
- Spelling		
Letters given (n=10)	0	2 (20%)
Word given (n=10)	0	0
- Identification of homophonous heterographic words (n=20 pairs)	17 (85%)	19 (95%)
- Lexical decision task (n= 20 pairs)	19 (95%)	20 (100%)

TABLE 5: *Number and percentages of correct responses in orthographic knowledge tasks.*

Identification of homophonic heterographic words: Another way to test logographic lexical memory is by having patients choose a correct word from a pair of homophonic words. Surface dyslexics, who read via the sublexical route, have been observed to have great difficulty with this type of test (Masterson, Coltheart, & Meara, 1985; Iribarren, Jarema, & Lecours, 1995).

Patients were asked to select from a pair of homophonic words the one that would fill a blank in a sentence with clear semantic clues with respect to the correct choice. Pairs of words were taken from Doezis (1986) and Huertas-García (1974). Whenever possible, special care was also taken to to keep the word category constant. Position of correct response was balanced.

TRP answered 17/20 (85%) correctly and CPG answered 19 (95%) correctly as can be seen in Table 5.

Lexical decision task (L12): Patients were asked to select a real word from a pair of stimuli in which one was a real word and the other a visually similar non word; there was at least 50% of common letters between word and non word of each pair. All non words ended in Spanish legal suffixes, in other words, the anomaly was in the stem; this was done in order to keep them as close as possible to real words. The

purpose was to see if the subjects would show visual confusion between these pairs of words and test their logographic input knowledge. There were 3 pairs of words for training and 20 experimental pairs. TRP answered 19 (95%) correctly, and CPG, 20 (100%).

Reading comprehension:

These tests were designed to see if patients were able to read words in isolation or in context via the semantic route. Results are shown in Table 6.

	Patient TRP	Patient CPG
Reading comprehension		
Multiple choice vocabulary questions (n=20)	18 (90%)	20 (100%)
Paragraph comprehension (n= 5 questions)	5 (100%)	5 (100%)

TABLE 6: *Number and percentages of correct responses in reading comprehension.*

Multiple choice vocabulary test: A definition was given and patients were asked to select the correct word from 3 choices. In each case there was a visual/phonological and a semantic distracter. The targets were selected from the list of nouns read previously, controlling imagibility and frequency. There were two training trials and 20 experimental items.

TRP gave 18 (90%) correct responses, she made 2 errors with low frequency nouns. CPG answered 100% correct.

Paragraph comprehension: A tests consisting of a story, called *El gusano y la mariposa*, and 5 multiple choice questions was taken from Ardila, Roselli, and Puente (1995). Patients had to read the story and then answer the questions. Both patients, TRP and CPG, answered 100% of the questions correctly.

Segmentation:

In this set of tests the capability of these patients to map a written word onto units of different levels was explored. Results are shown in Table 7.

Decomposition of words into syllables: This test allowed us to see if patients are able to perform graphosyllabic encoding appropriately. In this manner, we can test their visual analysis of words at the sublexical level. Twenty-two words with different levels of syllabic structure were typed on a paper leaving a space between each letter. Patients were asked to mark with a slash the boundary of each syllable in the word. The first two trials were for training.

TRP separated 13 words (65%) correctly but with great difficulty, and CPG answered 17 (85%) correctly but also with great difficulty.

Morphological decomposition: Two tests were designed to determine if our patients were able to map words onto a level higher than the syllable. Morphological knowledge about words is not always taught explicitly; in most cases, it demands a high level of education to become aware of the structure of words. For this reason, two tests were constructed; the first tested implicit morphological knowledge and the second, explicit morphological knowledge.

a. Recognition of morphological relationships: In this task the patients were asked simply whether words in a pair were related in meaning or not, controlling for orthographic resemblance. For this purpose 48 pairs of words were prepared in the following manner: there were 24 pairs of legal morphologically related words, 12 involving a prefix (e.g., [abrigo-desabrigo] = [shelter- lack of shelter]), and 12 pairs involving a suffix ([arroz-arrozal]. Then there were 24 more pairs of illegal morphologically related words in which orthographic resemblance was kept, 12 involving a pseudoprefix ([bajada- embajada] = [slope- embassy], and 12 a pseudosuffix ([ave- avería] = [bird - damage]).

TRP was able to answer all correctly. CPG identified 40 out of 48 pairs

correctly (83%)

b. Decomposition of words into morphemes: In this task the patients were asked to write a slash between the "meaning parts" of each word. Unlike the first test, this would require explicit knowledge about word structure. For this purpose a list of 60 words was prepared in the following way: 30 words involved prefixes and 30, suffixes. In each group there were 10 morphologically transparent words, i.e., those whose morphological decomposition poses no problem, for example: [anti-héroe] (anti-hero); 10 with opaque morphological structure, or words whose stems alone possess no meaning (e.g., [invasion] (invasión)), and 10 monomorphemic words with parts resembling either prefixes or suffixes (e.g., [desván]=(attic) or [algodón]=(cotton)).

TRP answered 35/48 (73%) items and then she refused to continue. Ten of her errors involved opaque words and 3, transparent words. CPG answered 50 words correctly (83%). One error involved an opaque word and the remaining nine errors involved transparent words -- he did not separate them but treated them as monomorphemic words.

c. Reading derivationally complex words: We saw that both patients had great difficulty reading inflected verbs and that they made a great number of morphological errors in reading all kinds of words. We wanted to see more clearly if this problem was related only to inflections or if derivations were as problematic. We asked the patients to read 24 derivationally complex words. TRP read 19 out of 24 words correctly (79%). Her errors were basically morphological errors. CPG was only able to read 10 words (42%) correctly. He made 12 morphological errors; in 8 cases he simplified the word, and in 4 cases he substituted the affix. He made one visual error ([escritura]->"esquituria" /eskituria/.), and one semantic paralexia, [numeroso]-> "muchas personas" (numerous -> "many people").

	Patient TRP	Patient CPG
Decomposition of words into syllables (n=20)	13 (65%)	17 (85%)
Morphological decomposition		
Recognition of morphological relationship (n= 48)	48 (100%)	40 (83%)
Decomposition of words into morphemes	35/48 (73%)	50 (83%)
Reading aloud derivationally complex words (n=24)	19/24 (79%)	10 (42%)

TABLE 7: *Number and percentages of correct responses in segmentation tasks.*

Summary of results

Although there were some instances of semantic paralexias, these two patients were classified as phonological dyslexics and not deep dyslexics because, first, their reading of words was much better than in deep dyslexia ; second, the number of semantic paralexias was extremely low; and third, there were almost no omissions. We found this pattern to be closer to what has been described for phonological dyslexia (Beauvois & Dérouesné, 1979; Patterson, 1982; Beauvois, Dérouesné, & Sallient, 1980).

The most outstanding result of this study is the inability of these two patients to read non words in comparison with their much better performance on words. In reading words the percentage of accurate responses for TRP was always above 83%, with the exception of long words (65%), morphologically complex words (inflected verbs = 55%; derivationally complex words = 79%), and words of foreign origin (53%). For CPG the percentage of accurate responses for words was above 70%, but

he had problems with inflected verbs (20%), long words (45%), compound words (45%) and words of foreign origin (22%). In contrast, for TRP the reading of non words was only 20% of legitimate non words, 35% for inverted words, although she did better with pseudowords (60%). CPG was unable to read a single non word correctly in the different non words tests.

With respect to the type of errors committed by these patients the most outstading result is the high number of morphological confusions in contrast with the very low number of phonemic errors of any type, including regularization errors; and also the low number of semantic paralexias and omissions. This pattern is also consistent with the picture of phonological dyslexia.

There are other pieces of evidence supporting lexical reading in these patients: there was a word category effect -- nouns and adjectives were read better than adverbs and verbs; there was also a length of word effect -- short words were read better than long words; and there was a non significant tendency to read high frequency words better than low frequency words. All these effects have been observed to be absent in non lexical reading (Kremin, 1985). On the other hand, their poor performance with foreign words might be due to the fact that these words were not familiar to the patients since they are native Spanish-speaking, monolingual subjects.

Tasks involving lexical access were performed with much ease by these patients; for example, the homophonic-heterographic discrimination tasks and the comprehension tasks (vocabulary and paragraph comprehension) were done very accurately. The implicit task of recognition of morphological relations, a lexical task, was performed with much ease as well.

As discussed in Dérouesné and Beauvois (1979) and in Lecours (1996), a purely lexical treatment of the information is not sufficient to explain the reading behavior of these patients. We could hypothesize that for TRP and CPG the problem seemed to be that of converting the grapheme into the corresponding phoneme, rather than any visual or graphosyllabic segmentation problem. At the level of letter

identification, TRP and CPG did not display any difficulty with allographic discrimination, a purely visual task, but had problems with naming letters, a task involving not only the visual recognition of the letter but also the phonological convertion needed to produce the name of the letter. Pairing words with homophonous non words was performed rather well, showing that TRP and CPG have a rather good sense of the graphophonological value of syllables. The restitution errors made by CPG in the inverted word task show that he is capable of some syllabic analysis. However, in comparison with global visual processes, segmentation tasks, syllabification and morphological decomposition were performed with difficulty although slightly worse than word reading.

The spelling tasks, either when words were spelled for them or when they were asked to spell words, were performed poorly. This suggests difficulties with the analytical treatment of information and/or problems with short term memory.

The fact that visual tasks were performed rather well by both patients and that they performed very poorly in reading non words, in spelling, naming of letters, and in non word repetition in contrast with word and short sentence repetition, suggests defects in the output phonological process, or phonosyllabic output register in Lecours' model (1996).

To summarize, both patients, TRP and CPG, showed the pattern of phonological dyslexia. Although the latter can be impaired at various levels, in the case of TRP and CPG, we can hypothesize that their difficulty lies mostly at a post-graphosyllabic stage and must involve a later stage than the syllabic-phonological conversion procedure. In Lecours' model (1996), the problem could be located at the level of the procedure between the input and output syllabic registers.

Discussion.

Two cases of phonological dyslexia have been presented in this study. This contradicts the claim of Ardila et al. (1989, 1991) that reading in Spanish always involves a phonologically mediated route, that the cognitive operation in reading

Spanish is only to convert graphemes into phonemes, and that reading disorders are determined by the language of the patient and not by any intrinsic aspect of the cognitive system. The incapacity of our patients to read non words (in spite of the high regularity of Spanish orthography), in contrast with their much better performance on real words, their good comprehension, and the type of errors they made, speaks directly against the assumption that lexical reading is not an option for Spanish-speakers. If we were to reject the hypothesis that these patients are using the lexical route, we would not be able to account for these data.

Evidence presented here suggests the universality of the reading and writing processes and their breakdown patterns. We do not believe that a script can deprive a reader of cognitive options. One orthography can favor one or the other reading strategy but, in the case of Spanish, for example, there is no a priori reason for a skilled reader not to use a lexical strategy to access a high frequency word. We believe that there is absolutely nothing in the Spanish orthography that will prevent a reader from processing the written word at a level higher than the grapheme-to-phoneme one. Neither the morphology nor the semantics of the word are obscured by its orthography. The linguistic description of the minimal graphemic unit of an orthographic system is one matter, its potential of representing a word at a different level is another matter entirely.

In an extensive revision of the influence of scripts on cognitive processes, Hung and Tzeng (1981) concluded that, at lower levels of processing, there seems to be a difference, but that at higher levels of processing, skilled readers in one system read as efficiently as skilled readers in another system.

Lexicalization processes have been observed to occur in other so-called shallow or transparent orthographies. In a study of children's reading acquisition in Finnish (another highly regular orthography), Kyötiö (1980) observed that, as for mechanical reading, reading Finnish might be easy, but that Finnish children have the same difficulties in comprehending and in other more developmental literary skills described for other languages.

In a study of 90 healthy Spanish speakers, Cuetos (1993) found both lexical priming and grapheme frequency effects, and concluded that in these subjects both reading routes were available.

It might be that our subjects are more literate than Ardila's subjects, and that lexicalization develops as literary skills improve. Perhaps the fact that a non negligeable degree of irregularity exists in writing in Spanish, i.e., there are some phonemes that can be represented by more than one grapheme, even more so in Latin American Spanish, forces the reader to construct a rich logographic lexicon as his/her literary skills develop.

This problem certainly requires further study and testing. However, although orthographic structure is a variable that should be taken into consideration, we reject the strongest version of the DOH, which denies that the normal brain ever develops connections between global patterns and semantics in highly regular orthographies (Bridgeman, 1987; Turvey et al., 1984). Whether we observe the different reading syndromes described for some orthographies like English and French will depend on the tasks and choice of stimuli to allow for finer analysis of the reading processes and of the difficulties they pose to a reader. Moreover, deeper analyses are needed to clarify the specific subprocesses involved in each reading impairment.

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Notes

[1] Throughout the text, this index refers to the tests in Lecours (1996), however, stimuli in Spanish were chosen by us.

[2] Words of foreign origin are not listed in the dictionary of the Royal Academy of the Spanish Language (Diccionario de la Real Academia de la Lengua Española, RAE).

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Chapter 7:

Two different dysgraphic syndromes in a regular orthography, Spanish.

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Abstract

In opaque orthographies, such as English and French, three central dysgraphic syndromes have been described: surface dysgraphia, phonological dysgraphia, and deep dysgraphia. Writing breakdown patterns reveal that spelling can proceed by phoneme-to-grapheme conversion, or by a more direct or lexical approach. Ardila et al. (1989, 1991) claim that for Spanish speakers a lexical strategy for reading and writing is not an option due to the regularity of the orthography of this language. In this study we report two clear cases of dysgraphia in Spanish, one of surface dysgraphia and another of phonological dysgraphia, where a dissociation between lexical and sub-lexical writing can be observed, thus contradicting Ardila's position.

Introduction.

Since the pioneering works of Marshall and Newcombe (1966, 1973) and Beauvois and Dérouesné (1979), it has been relatively well established that the central acquired reading disorders can be classified into surface dyslexia, deep dyslexia, and phonological dyslexia. This classification is supported by the observation that there are patients who seem to have difficulties reading at the lexical level (surface dyslexia), patients who seem to have difficulties with the sublexical route of reading (phonological dyslexia), and another group that

seems to have serious problems with the sublexical route of reading and perhaps with the lexical route as well (deep dyslexia) (Lecours, 1996; Morton and Patterson, 1987; Shallice and Warrington, 1987; Valle Arroyo, 1992). With respect to writing, parallel deficits to those observed in reading have been reported.

Beauvois and Dérouesné (1981) and Hatfield and Patterson (1983) found patterns of acquired writing disorders equivalent to those of surface dyslexia. That is, these patients had great difficulty writing to dictation words with irregular sound to grapheme correspondence, and their errors when writing this type of words were phonologically accepted; for example, the French word "FEMME" written as "FAM," or the English word "SENATE" written as "CENET." Shallice (1981) described the case of a patient who could write 90% of different types of words correctly but only about 26% of nonsense syllables: This pattern corresponds to phonological dysgraphia syndrome. On the other hand, Bub and Kertesz (1982) encountered the case of a patient who exhibited all the symptoms corresponding to deep dysgraphia. His errors could be classified as semantic paralexias (e.g., TABLE for CHAIR), visual errors (e.g., AROUND instead of AMOUNT), he spelled concrete nouns better than abstract noun, showed word category effect, and was unable to write any nonword to dictation. Hatfield (1985) found another patient with the same writing difficulties, who also wrote words in a nonlinear order. Hatfield argues that the nonlinear writing reflects a lexical-visual strategy for writing or at least a non-phonological strategy.

The observation of these acquired writing deficits seems to indicate, as in the case of reading, that there must be at least two ways in which a word can be spelled: a sub-lexical strategy for writing or the conversion of every phoneme into its corresponding grapheme in a sequential order; and a lexical strategy that would imply accessing of the orthographic representation of the whole word and from there planing the necessary hand movements to write it. Phillips and Goodall (1995) refer to the first strategy as "assembled spelling," and to the second as "addressed spelling." Apparently, the lexical strategy can be accomplished by accessing the meaning of the word before its orthographic

representation, or without even understanding the meaning of the word. Phillips and Goodall (1995) have documented the case of a patient who can write non-semantically but lexically.

The different deficits observed in the reading and writing behavior of brain injured patients have given rise to several models of reading and writing. One of the most specific is that of Lecours (1996). It offers a series of hypothesis and testing procedures for each hypotheses about the possible sub-processes involved in reading and writing. Lecours' model also incorporates the possibility of testing for the different reading and writing strategies in different writing systems. It has been acknowledged that the orthographic structure of a language is of crucial importance in the manifestations of the dyslexic and dysgraphic syndromes (Caravolas, 1993; Frost, 1992, 1994; Katz and Feldman, 1983; Katz and Frost, 1992; Kavanagh and Venezky, 1980; and Tzeng and Wang, 1985). It seems that it is the irregularity of the orthographic structure of a language that forces an individual to learn the spelling of particular words and to construct a sort of mental storage for the particular spelling of each word. Apparently, the more regular the orthographic structure of a language the less need to rely on orthographic knowledge to access the correct spelling of a word.

Ardila et al. argue that in the case of Spanish, due to the regularity of its orthographic structure: "the psycholinguistic models of the alexias and the agraphias developed in other languages, particularly in English, do not seem to be appropriate to Spanish" (Ardila, Rosselli, and Pinzón, 1989, p.173). According to these authors, "Reading English and reading Spanish are undoubtedly two different cognitive tasks...Reading in Spanish is always mediated through phonology" (Ardila, 1991, p, 444). Ardila et al. (1989) base their conclusions on the supposedly "almost complete phonological writing system" of the Spanish language which would render the development of a lexical strategy for reading and writing unnecessary. With respect to reading, Ardila's claim has been proven to be very problematic since cases of surface, phonological, as well as deep dyslexia have been reported by several authors (Cuetos, Valle-Arroyo, and Suárez, 1996; Ferreres and Miravalles, 1995;

Iribarren, Jarema, and Lecours, 1996; Iribarren, Jarema, and Lecours, in print; Ruiz, Ansaldo, and Lecours, 1992). The different cases of patients described in these studies show the same symptoms and reading behavior described for languages of opaque orthographies. If the possibility of a lexical reading strategy were to be rejected as an option for Spanish speakers, then the data presented in these studies could not be explained appropriately. On the other hand, cases of acquired writing difficulties have not been well documented in the literature. We will present two cases of dysgraphia in Spanish monolingual speakers that will show, on the one hand, difficulties with the lexical strategy of writing, and on the other hand, difficulties with the sublexical strategy for writing, in other words, one case of surface dysgraphia and one case of phonological dysgraphia.

The orthographic structure of Spanish is such that there are almost no irregularities in reading because every grapheme is pronounced in one way, but there are several irregularities in writing, since there are some phonemes that can be written in more than one way. When reading, there are only three exceptions: 1) the letter 'X' that can be pronounced /s/ as in '*xenofobia*', /gs/ as in '*examen*', /ks/ as in '*tórax*', and /h/ as in '*México*'; 2) the letter 'Y' takes a vocalic value as a conjunction and a consonantal value in any other context; and 3) the letter 'R' at the beginning of a word or before 'N' must be read as if it were 'RR'. However, on the writing level there are at least six exceptions, but these are widely used. These "irregularities" derived from the fact that Spanish orthographic rules are determined not only from the phonology of the words , but also, and very importantly, from the etymological origin[1] (Alonso, 1982; Chacón, 1986). Thus, we find that the phoneme /b/ can be transcribed either as 'B' or 'V' depending on the meaning of the word. Also the letter 'H' is kept even if it is mute. For example, beginning the 18th century, words that were originally written with 'F' in Latin were transcribed into Spanish with 'H' (e.g., '*hacer*' from '*facer*'). The phoneme /h/ before /e/ and /i/ can be written

[1] Unfortunately, this fact is not exploited when teaching children to read and write since it is assumed that the orthography of words is strictly phonological. Children are taught using the phonic method. The etymological explanation is basically found in advanced orthographic manuals for adults.

either with 'G' or 'J', and even with 'X' (e.g. Xeréz, Ximena). Perhaps this originated from dialectical differences. In the 17th century, the word /hente/ (people) was written interchangeably as *gente*, *jente*, and *xente*. In Spanish from Latin America, the phoneme /s/ can be written with 'S', 'Z', in some contexts with 'C', and even with 'X'. The phoneme /j/ can be spelled either 'LL' or 'Y'. The stress pattern of a word must be marked graphically adding another source of confusion for the writer, since the stress pattern of Spanish words is highly lexicalized (Harris, 1983). Although these irregularities seem to be low in number in comparison with those found in other languages such as English and French, they appear very often in common vocabulary; that is, they are not reserved for obscure or technical vocabulary. A Spanish writer must acquire an ample visual lexicon in order to write correctly. Writing in Spanish is not a question of mere phonological transcription.

Case 1:

Patient I.T. is a 69-year-old retired medical doctor. He is right handed with no history of left handedness in the family (The Edinburgh Inventory, Oldfield, 1971). The patient had a history of high blood pressure. In September 1986 he had the first symptoms of a CVA: loss of consciousness, right hemiparesia, speech impairment, and the total loss of the capacity to read or write. He spent 15 days in the hospital. A thrombosis in the left hemisphere was diagnosed, and 8 months later he was operated on. A CT scan, performed on February 27th 1988, revealed an old lesion in the left temporo-parietal area, and recent lesions in the left anterior inferior temporal area, and posterior areas of the temporal and parietal lobes. There were less severe lesions in the ventricular region, and bilateral subcortical damages. For his age, I.T.'s hearing is normal, according to an audiological exam. He wears eyeglasses, and in a confrontation test he showed right homonymous hemianopsia. At the time of our evaluation, the patient had recovered all of his motor and tactile abilities.

His short-term memory was slightly affected for his age (Serial Learning Test, Luria, adapted to Spanish by Ardila, Rosselli, and Puente, 1994). His attention was normal ("A Cancellation Test," Ardila, Rosselli, and

Puente, 1994). He showed acalculia for multiplication and division. He presented agnosia for recognizing his own body (autopagnosia), but did not present any of the other agnosias. He showed constructional apraxia (Rey-Osterrieth Figure Test), but did not reveal any of the other apraxias.

According to the adaptation into Spanish of the BDAE by García Albea and Sánchez Bernardos (1986), I.T. is a non-fluid aphasic, he is agrammatic, and suffers severe anomia. His automatic language is preserved. He uses gestures and stereotypical expressions to communicate; however, he can be very effective communicating and likes to tell stories. He made phonemic paraphrasias during a repetition test (our test), and he has a slight comprehension deficit, sometimes with a delay of longer than 5 seconds to recognize words or commands. He showed all the symptoms of surface dyslexia , but that is reported elsewhere (Iribarren, Jarema, and Lecours, 1996). We will discuss his writing in more detail after presenting Case 2 in order to make the relevant comparisons.

Case 2:

Patient A.M.P. is a 56-year-old woman who worked as a X-rays technician in a public hospital until her CVA. She is right handed with no history of left handedness in her family (The Edinburgh Inventory; Oldfield, 1971). She studied until third year high school and then went for technical training in the hospital where she worked. On July 13th, 1994 she was brought to the hospital because of a thyroid crisis. She presented right hemiplegia, incoherent speech, and loss of muscle tone; however, she did not lose consciousness. She stayed in the hospital for 20 days. A CAT scan revealed an ischemic accident in the left temporo-parietal area.

She wears eyeglasses. Her color vision, eye motricity, pupil reflexes, and visual fields are preserved. According to an audiometric test she presented some hearing loss (R = 26%, L = 29%, and Both 27%). She has recovered completely from her motor and sensorial difficulties. She presented a slight acalculia. A.M.P. did not reveal any of the agnosias, nor any of the apraxias except for constructional apraxia. Her performance on the Rey-Osterrieth

Figure test was very poor. Her language was evaluated with the adaptation into Spanish of the BDAE by García Albea and Sánchez Bernardos (1986). She showed a slight agrammatism , but it is difficult to determine if this is not due to her level of education. Her reading evaluation (Protocol adapted and developed by Iribarren for Spanish based on Lecours, 1996) showed difficulties with spelling aloud and syllabification tasks; otherwise, she could read every type of word with 98% of accuracy. Her discrimination of homophonous words was 100% correct (25/25), and reading comprehension was very high as well. She could read nonwords accurately. In other words, she did not present any of the dyslexias. Her writing will be described in detail in comparison with the writing of the patient I.T.

Writing performance of patients I.T. and A.M.P.:

The writing of these two patients was evaluated with the protocol adapted and developed by Iribarren for Spanish based on Lecours (1996).

Spontaneous writing: Both patients had what can be considered a good handwriting. Their writing is very clear, letters are very legible, adult-like, and the use of the space on the paper is very appropriate. They both wrote their names clearly and fluently. When asked to write a few sentences, I.T. produced only one sentence , but it was fluid and grammatically correct. A.M.P. wrote two short sentences, grammatically correct, but she made one phonological paragraphia. She wrote: "*Voy para mi casa. Me voy a ballarme*" (trad. "I'm going home. I'm going to take a bath") – "*ballarme*" instead of the correct form "*bañarme.*"

Copying:

a) *Free copy*: they both copied 5 high frequency words correctly.

b) *Allographic conversion, from print to handwriting*: I.T. and A.M.P. did not make any errors (5/5), but *from handwriting to capital letters*, I.T. did not follow the instructions and copied the five words correctly, but in his own

handwriting. It must be mentioned that the instructions were stated clearly enough; A.M.P. made a phonological error transcribing "*dinero*" as "*DYNERO*," and omitted the longest word "*antropólogo*."

c) *Sentences:* were copied correctly by both patients.

d) *Copy of legitimate nonwords*: I.T. made two phonological paragraphias ("reco" -> "resio," and "mechinasa" -> "cechiasa"), and after several attempts, A.M.P. refused to copy the five nonwords, demostrating a high level of frustration.

Spelling: Both patients had trouble with both supplying a word when it was spelled to them by the researcher, and spelling aloud a given word.

Dictation of words: For this test, 160 words were selected controlling for index of frequency, grammatical category, regularity of spelling, concreteness, etc. A.M.P. exhibited a high level of accuracy when writing all kinds of words to dictation, whether these were regular or irregular, high or low frequency, or of any grammatical category. Out of 160 words, she made only two errors that could be attributed to her level of education. She wrote "*televicion*" for "*televisión*," and "*voca*" for "*boca*" (These are both high frequency concrete nouns). On the other hand, I.T. made numerous spelling errors. Out of the 160 words he made 7 errors writing the 80 regularly spelled words, and 31 errors writing the 80 irregularly spelled words. His errors writing regularly spelled words were all phonological paragraphias producing neologisms (e.g. "*calentario*" =? instead of "*calendario*" = "calendar," "*cosquialidad*" =? instead of "*cordialidad*" = kindness). When writing irregularly spelled words, he made 90% of regularization errors, that is, he made phonologically plausible substitutions (e.g., "*excases*" instead of "*escasez*," "*pezcado*" instead of "*pescado*," "*cullo*" instead of "*cuyo*," "*penzaba*" instead of "*pensaba*," "*haguafiesta*" instead of "*aguafiestas*"); and he made 10 % of phonological paragraphias producing neologisms ("*melleza*" instead of "*belleza*," "*hinsidemo*" instead of "*incitemos*"). In other words, regularity of orthographic representation had a strong effect on his accuracy. According to a X^2 Test, this

difference reached the p. <001 level of significance. Length of the word had no effect, but he made more errors writing low frequency than high frequency words although this did not reach any level of statistical significance. He had more difficulty writing nouns than any other grammatical category. Words with graphic accent were particularly problematic for him. He tended to omit the graphic accent, producing a regularization error.

Dictation of legitimate nonwords: 20 nonwords with no visual or phonological similarity to any Spanish words, but respecting the syllabic structure of the language were constructed for this test. They were constructed in this manner to avoid the effect of writing nonwords by analogy with real words reported for Spanish writers (Sebastián Gallés, 1991). Patient I.T. wrote 17 out of 20 nonwords correctly (85%). His errors were again phonological in nature ("*seidocu*" -> "*seiboco*," "*fecelio*" -> "*cecelio*," and "*vesmaca*" -> "*desmaca*"). He wrote all nonwords quite fluently and sometimes repeated to himself what he heard. On the contrary, for patient A.M.P. this task proved to be too difficult. She asked the experimenter to repeat to her each nonword several times, made several unsuccessful attempts that she would erase or cross out, and finally gave up. She did not succeed with any of the nonwords.

Table 1. Percentage of correct responses in writing words and nonwords.

Type of word	n	I.T.	A.M.P.
Nouns	48	48%	96%
Function words	20	85%	100%
Adjectives	20	85%	100%
Adverbs	20	85%	100%
Verbs	36	80%	100%
Graphic accent	16	33%	100%
Nonwords	20	85%	0
Foreign words	10	30%	0

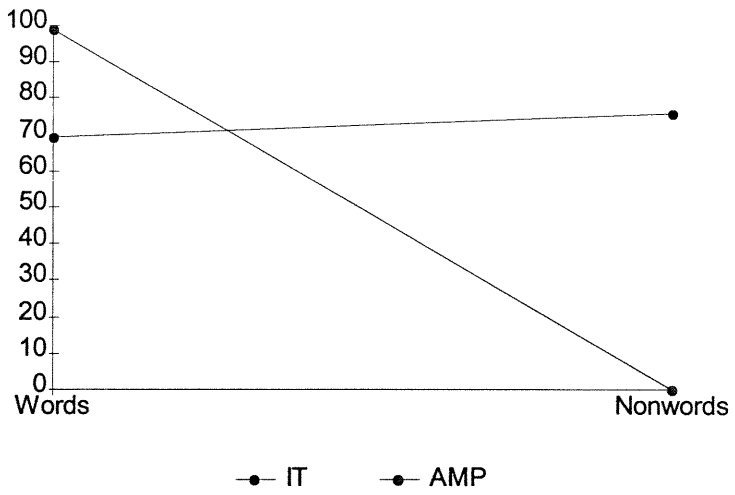
Writing to dictation words of foreign origin: In Spanish there are a number of borrowed terms from foreign languages whose orthographic structure may or may not coincide with that of Spanish. These are found in the Spanish dictionaries and are widely used, although they are systematically excluded from any statistical study of this language. We selected 10 words of this kind whose orthography did not correspond to that of Spanish and dictated those to the patients. I.T. wrote only 3 of these words, omitting the rest and again made phonologically plausible substitution: "*lady*" -> "*leidi*," "*life*" -> "*laif*," and "*motor-home*" -> "molojon" (in Spanish the phoneme /h/ is written with the grapheme "J"). A.M.P. refused to write any saying that these words were too strange and did not exist.

Writing homophonous words in context: In this test a definition or semantic clue of a word is given to the patient and he/she is expected to write it, but target words have homophonous counterparts. 10 such definitions were given. I.T. wrote 6 correctly, committing phonological paragraphias with the other 4. A.M.P. wrote 9 words correctly and her mistake was a semantic paragraphia. She wrote "uno" instead of "As" for the clue "the first card of a poker card set"; we acknowledge that this is a very low frequency word.

To summarize results, we observed that both patients have good handwriting and good use of the space on the paper. They both wrote rather fluently. Patient I.T. writes words and nonwords with about the same level of accuracy although nonwords are written slightly better than words (76% and 85% respectively). I.T.'s errors are basically phonological paragraphias that produce regularization errors and sometimes neologisms, but with phonological resemblance to the target word – that is, there are no visual similarities between the target and the written production of the patient, but rather a phonological resemblance (e.g., "*melleza*" for "*belleza*"). I.T. also showed homophonic confusions writing 6 out of 10 homophonous words correctly and again making phonological errors. On the other hand, patient A.M.P. writes all kinds of words without much difficulty (99%), but is

completely unable to write nonwords, either copying them or writing them to

Graph 1



dictation. Her inability to write words of foreign origin can be explained if we consider that, due to her lower level of education, these words must be like nonwords to her. Also her spelling errors are not different from those observed in low education level adults for Spanish. These also consisted in the phonological paragraphias possible in this language given its orthography. A.M.P. did very well writing homophonous words. What we observe in these two patients could be considered a double dissociation: I.T. writes nonwords slightly better than words, showing a regularization pattern of errors, and AM.P. is able to write real words regardless of orthographic regularity , but is completely unable to write nonwords (Graph 1).

Discussion.

The first observation we can make from the two cases described here is that these are examples of central rather than peripheral dysgraphia. These patients both have good handwriting and make appropriate use of the space on the paper. Therefore, their errors cannot be explained in terms of difficulties with the graphic-motor patterns required for writing or any other sensorial

impairment, but rather they must be interpreted as central or deficits related to the accessing of the orthographic representation of words at the different levels necessary for spelling (Papagno, 1992; Lambert, Viader, Eustache, and Morin, 1994).

Patient I.T. shows the same pattern of writing impairment corresponding to surface dysgraphia. That is, he makes regularization errors when writing irregularly spelled words, he writes words and nonwords at about the same level of accuracy, and shows confusion when writing homophonous words (Beauvois and Dérouesné, 1981; Hatfield and Patterson, 1983). On the other hand, A.M.P. shows the pattern of writing deficit described for phonological dysgraphia. She can write any kind of real word with a high level of accuracy for her educational level, and she is completely unable to write nonwords, either by copy or by dictation (Shallice, 1981; Hatfield, 1985). This is particularly surprising, since the orthographic system of Spanish is supposed to be less irregular than English or French. The only possible way we can interpret her writing behavior is that she is using a lexical strategy, because if she were using a phonological strategy she would not present any difficulties when writing nonwords. She does not show homophonic confusion either which is considered a typical problem for someone using a non-lexical approach to writing.

The evidence presented here points towards the idea of the universality of reading and writing processes. This contradicts Ardila's claim of the need to design models and theories of reading and writing specific for each language and its orthographic structure. The writing behavior of patient A.M.P. is particularly interesting because it shows that lexical writing is an option for Spanish as well, and that a visual orthographic lexicon develops in Spanish readers in spite of the small number of exceptions in the regularity of its orthography, and even in individuals that do not have a high level of education. On the other hand, patient I.T., an individual with a high level of education (he earned an M.D.), has lost the capability of using a lexical strategy, and consequently can only utilize a phonological or non-lexical strategy and this results in a writing of lower quality than that of patient A.M.P.

With these two cases it has been shown that for Spanish writers the two routes described for writing other languages are also an option; that is, a Spanish writer has a phonological transcription strategy and a non-phonological or lexical strategy available to him/her when writing. Considering that the orthography of Spanish words is based not only on the phonology , but also on the etymological information of the word, it would be expected that a writer develops some sort of visual orthographic memory that will allow him/her to write correctly any kind of word, but particularly those containing phonemes that could be transcribed with more than one grapheme. Relying solely on a phonological transcription strategy will not produce correct spelling in every case. As we mentioned before, although the irregularities of the Spanish orthography are very limited in number, they show up very frequently in ordinary language. This would necessarily force the writer to develop a wide visual orthographic lexicon to be able to write most words correctly. In other words, although Spanish is quite regular at reading, it is not at writing, and this has consequences in the acquisition and deficits observed in this language.

In a study of the writing of children of different ages, Valle Arroyo (1989) found that when he dictated words and nonwords to them, their errors reflected the use of a sub-lexical as well as a lexical route. Cuetos (1993) found in a group of Spanish healthy adults that their writing of nonwords to dictation was sensitive to the frequency of the spelling of particular sounds and also to lexical priming. He concluded that this reflected the availability of the two strategies to writers reported for deep orthographies. Our findings with dysgraphic patients do not contradict these studies with children and healthy adults.

We do not ignore the importance of the nature of the writing system used in a language as a factor influencing the acquisition, processing, and breakdown patterns of the reading and writing processes. On the contrary, it must be always taken into consideration when designing the instruments and evaluation protocols to test the hypotheses related to these processes. We have proved that with the appropriate testing protocols the existing theories and

models of reading and writing can be studied more adequately. We have also shown that Spanish at the writing level is not as regular as originally believed. We do not know if a completely regular orthography at both reading and writing would be acquired and processed according to Ardila's predictions. At least this is not the case for Spanish, but such a proposition should be studied further.

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Chapter 8:
Conclusions.

We have presented evidence of the existence among Spanish speakers of the same dyslexic and dysgraphic syndromes described for deep or irregular orthographies like English and French. Based on Lecour's model and protocol of evaluation, we have systematically tested the different sub-processes hypothesized to be involved in reading and writing, and we have found the predicted dissociations for other languages in the native Spanish dyslexic patients that we examined. This supports the view that the cognitive processes involved in reading and writing are universal and not language specific as claimed by Ardila et al. (1989, 1991).

A case of surface dyslexia in a native Spanish speaker was presented in Chapter 5; that is, a patient who committed a significant number of regularization errors when reading irregular words could read nonwords without much difficulty, did not show word frequency, word category, word length, or word imageabilty effects, and performed at chance level in a task of discrimination of homophonous words. This reading behavior corresponds in every sense to the pattern of surface dyslexia described for English and French (Friedman and Hadley, 1992; Marshall and Newcombe, 1966, 1973; McCarthy and Warrington, 1990, Masterson, Coltheart, and Meara, 1985; Patterson, Coltheart, and Meara, 1985) Our main contribution in this respect was the devopment for Spanish of a task to test the reading of irregular words, given the regularity that exists in the reading of this language. We took advantage of the fact that the stress pattern of Spanish words is highly lexicalized (Harris, 1983), and that the correct stress pattern cannot be predicted by the graphemes-to-phoneme conversion. Therefore, the incorrect assignment of stress in reading a word in Spanish can be considered a regularization error, or at least as a failure of the lexical recognition of the word. This patient made the predicted errors and assigned the unmarked stress pattern to these words.

On the other hand, the reading impairment pattern show by patients T.R.P. and C.P.G., presented in Chapter 6, revealed serious difficulties with

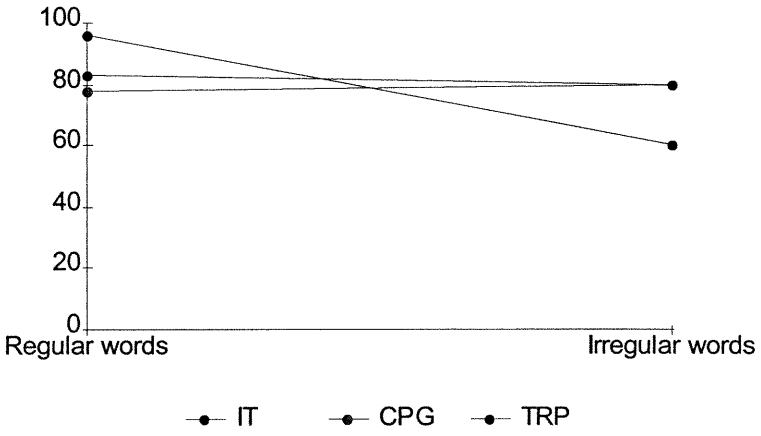
reading at the sub-lexical level in Spanish, their native language. These two patients were able to read regular and irregular words at about the same level of accuracy, however, they had major problems when attempting to read different kinds of nonwords. They showed word grammatical category effects, and a non-significant tendency to read high frequency words better than low frequency words. They read short words better than long ones, and they did not show confusion with homophonous words. They did not commit regularization errors, but their morphological errors and visual confusions were high; and also they made some semantic paralexias. These are the same reading impairments displayed by phonological dyslexic patients in English and French (Beauvois and Déreousné, 1979; Beauvois, Déreousné, and Saillant, 1980, Funnel, 1983, Job and Sartori, 1984; Patterson, 1982; Sartori, Barry, and Job, 1984).

Although we have discussed the cases separately, comparing the performance of these patients in the most relevant tests and the different kinds of stimuli, we can observe the dissociations predicted by Lecours' model and the other dual-route models. The comparison of the reading performance of these three patients can be appreciated better in the following graphs.

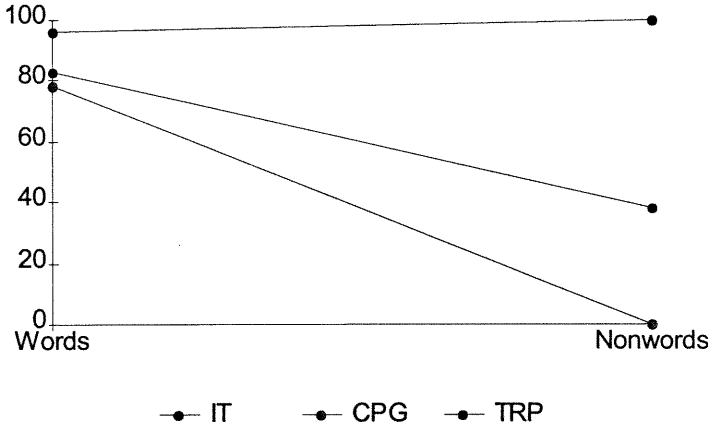
In Graph 1 (page 163), we can see that for I.T. the reading of regular words is easier than the reading of irregular words. On the other hand, for T.R.P. and C.P.G. there is no effect on their reading accuracy with respect to the regularity of the spelling of the words. According to the Chi-square test, between subjects, this difference reaches a significance level of $X^2 = 6.49$ ($p < .02 = 5.41$).

In Graph 2, we observe that for I.T. there is no difference in the reading of words and nonwords. In fact, he reads nonwords slightly better. T.R.P. and C.P.G., on the other hand, have a very low level of success when reading nonwords in comparison with the reading of words. Between patients, this difference reaches a high level of significance: $X^2 = 65.06$ ($p.<.001 = 10.83$).

Graph 1

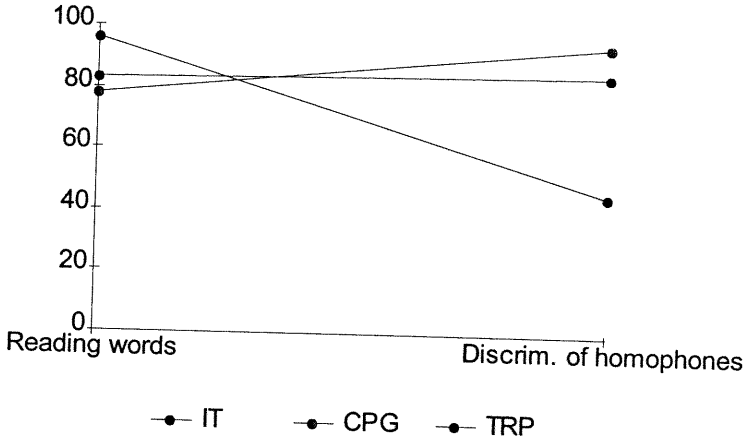


Graph 2



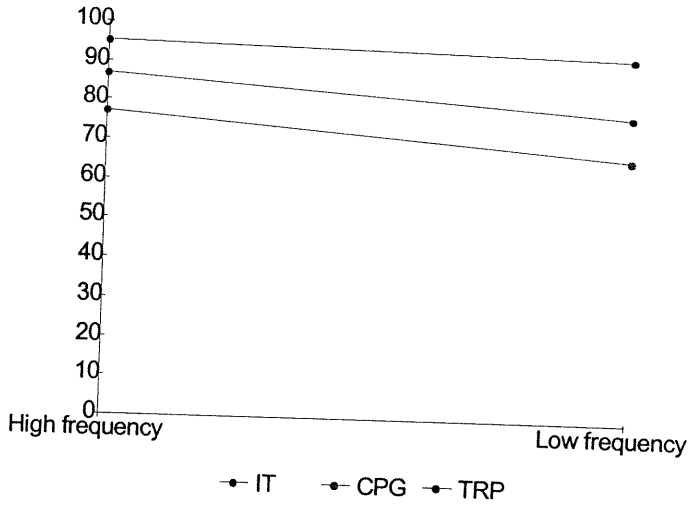
Confusion of homophonous words is another indication that a patient has difficulty with the accessing of the visual orthographic representation of a particular word, since in the case of homophony grapheme-to-phoneme correspondence is not enough to differentiate words that sound the same. In Graph 3, we can contrast the performance of patient I.T. with that of patients T.R.P. and C.P.G. in regular word reading and recognition of homophonous words. T.R.P. and C.P.G. read regular words less accurately than I.T., but they do a good job of discriminating visually homophonous words. I.T. shows the opposite pattern. This difference is statistically significant at the p.<.001 (X^2 = 17.36, p. = 10.83).

Graph 3

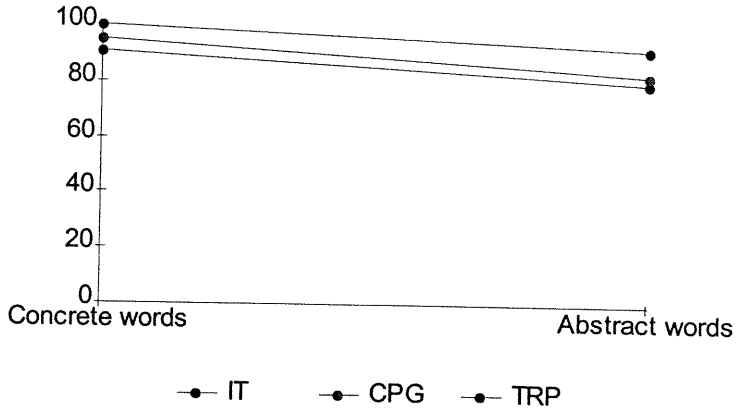


In Graphs 4 and 5, we can see the performance of these patients with respect to index of frequency and level of abstractness. Between patients, the differences observed do not reach any level of statistical significance. On the other hand, in Graph 6, we can see how for patient I.T. there is no difference in his accuracy for reading either short or long words, but for patients T.R.P. and C.P.G. there is a word length effect. Between patients this difference is significant at the p. <.01 level (X^2 = 7.85, p. = 6.64).

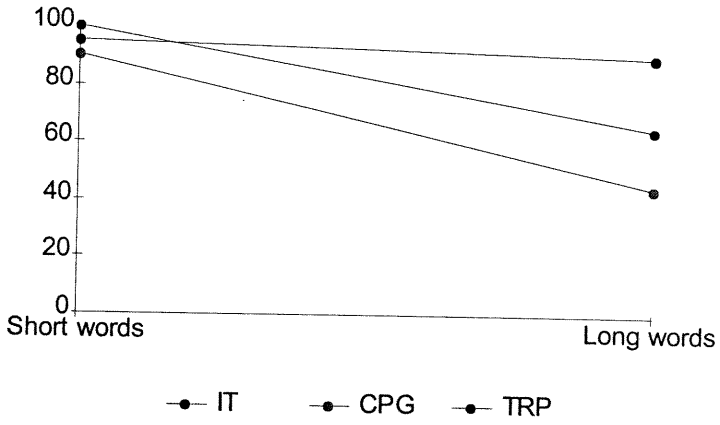
Graph 4



Graph 5



Graph 6



The observation of these dissociations in the reading performance of these patients could not be interpreted correctly according to Ardila's claim that a lexical strategy for reading is not an option for Spanish speakers, and that reading in Spanish is basically a problem of converting graphemes to their corresponding phonemes.

Ardila's claim is problematic in two senses. On the one hand, it implies that there should not be cases of patients who can read words but not nonwords, and that, therefore, neither phonological nor deep dyslexia should be observed in this language since a lexical approach to reading is not an alternative in the case of Spanish readers. However, we have described two clear cases of phonological dyslexia. There is another case described by Cuetos, Valle Arroyo, and Suárez (1996), and cases of deep dyslexia have been described as well by Ferreres and Miravalles (1995) and Ruiz, Ansaldo, and Lecours (1992). On the other hand, the assumption that the orthographic representation of Spanish is "transparent" in every sense is not completely correct because it does not take into consideration other aspects of the graphic representation of the pronunciation of words, for example, the stress pattern.

In Spanish, the serial conversion of graphemes into phonemes is not sufficient to produce the correct pronunciation of every word. Although the stress patterns of words is marked diacritically, this information must be learned. Stress pattern regularization errors are commonly heard in children learning to read before they develop the skill to correctly interpret the stress graphic mark and acquire a sufficient visual vocabulary (Signorini, 1997). In this sense, Ardila's analysis of the orthographic structure needs to be reinterpreted as well.

In Chapter 7 of this thesis we have already presented the dissociation in writing described for opaque orthographies. Since the Spanish orthographic structure is not so regular with respect to writing, this was expected. Although irregularities of spelling are not as numerous as in French and English, these are commonly used. There is morphological as well as etymological information in Spanish spelling. Writing Spanish is not a mere phonological transcription. That would not produce the desired results. As we saw in Chapter 7, when a patient loses access to the orthographic representation (surface dyslexia) a phonological transcription will not always help him to write every word in Spanish correctly. On the other hand, the fact that a patient can write words rather accurately but is completely unable to write nonwords (phonological dyslexia), supports the idea that a visual lexical strategy is available for Spanish writers as well, and of course, the dissociation between lexical and sub-lexical writing can be observed in this language too.

We are aware that reading and writing do not share all modules and procedures (Lecours, 1996), however, they do share some of them. Usually, these two skills are acquired simultaneously, and they both depend on the orthographic representation of the particular language. We think that the fact that at the writing level the Spanish speaker needs to acquire a visual lexicon in order to write correctly may have consequences for his reading as well. The irregularity found at writing and the subsequent development of an orthographic representation might help in the development of a lexical strategy for reading as well. This is a problem that needs to be studied more carefully.

We do not know if in a completely regular orthography, at both the reading and writing level, Ardila's claim could be observed. We can say that this is not the case for Spanish. However, we do not think that in Spanish the level of description of the orthographic system itself prevents the reader or writer in any way from accessing the meaning or pronunciation of a written word at a different level. As hypothesized in Lecours' model, the graphic signs can be grouped together at different levels and interpreted accordingly. As has been expressed by Marshall (1989), the linguistic description of the orthographic structure of a language should not be confused with the cognitive faculties available for the processing of such signs.

We found that with the appropriate descriptions, tasks, and selection of stimuli, the universality of the neurolinguistic processes for reading and writing can be proven. This methodology reflects a manner of working and testing hypotheses in the area. We favor a systematic way of collecting information in order to identify problems as precisely as possible. On the one hand, the quality of the information helps in the design of appropriate therapies for patients, and on the other hand, a systematic approach always helps in the understanding of the underlying hypotheses of the models proposed for reading and writing. In addition, it allows for comparisons with other studies of the same nature. We are aware that this protocol of evaluation can be improved in more than one manner. The selection of stimuli can be improved once the statistical studies of Spanish, particularly of vocabulary use in Venezuela, are updated. We hope that this kind of studies will be carried out in the near future and this will affect the selection of the stimuli for this evaluation protocol. Moreover, questions will always emerge that can not be answer with this particular set of tasks. However, following the same methodology new tasks can be designed; that is, tasks developed based on explicit and specific hypotheses.

With this evaluation protocol we have studied several cases of reading and writing impairment. The cases described in this thesis are only a selection among several patients studied. The more cases we can study, the more we

will be able to clarify further the questions examined in this thesis and explore at a deeper level the particular aspects related to each of the two routes available for a reader/writer of a language like Spanish. There are still many questions to be answered with respect to the manner in which written language is processed.

The information presented in this thesis is only a small contribution to the studies of the consequences and implications for the acquisition, processing and breakdown patterns of reading and writing with respect to the orthographic structure of a language. We hope that the evaluation protocol developed here will help speech therapists, and particularly patients, or those suffer the overwhelming experience of losing the faculty of reading and writing that is so indispensable in the contemporary world.

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