Implicit reading in Letter-by-Letter Dyslexia:
A case report

Davide Crepaldi, Silvia Aggujaro, Enrico Ripamonti and Claudio Luzzatti

Department of Psychology, University of Milano-Bicocca, Milano, Italy

INTRODUCTION

Letter-by-Letter (LBL) *dyslexia* is a peripheral reading disorder in which a written word cannot be processed either by the lexical or by the sub-word-level routine. However, patients may still be able to name single letters of a strings and retrieve the phonological representation of a written word through an inverse spelling procedure.

LBL reading is usually associated with left occipital damage and caused by a disconnection of the word-blind right hemisphere (RH) from the word recognition system in the left hemisphere (LH), (see Déjerine's [1] interpretation of pure alexia). According to this view LBL readers would have no residual reading abilities.

The critical features of LBL reading are:
- linear increment in the time needed to read increasingly longer words
- deleterious effects of tachistoscopic presentation:
  reading becomes impossible as the time of exposure becomes shorter than the time required for an effective LBL strategy.

Coslett & Saffran [2] described four LBL dyslexic patients who performed better than chance either on lexical decision or on semantic judgment tasks with words that could not be explicitly identified (*implicit reading*).

Data on LBL reading have been mostly obtained in French and English (languages with largely irregular orthography), but similar results have been also reported for languages with shallow orthography, like Italian [3].

The present study aims:
- at providing data on the nature of the implicit reading phenomenon
- at comparing reading abilities in English and Italian by a bilingual LBL dyslexic patient.

CASE HISTORY

CM is a 63-year-old native speaker of American English, who has lived in Italy for 30 years. She suffered a left occipital CVA, which resulted in complete right hemianopia and severe (almost pure) reading impairment.
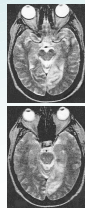
- *Spontaneous speech*: fluent with no phonological, lexical-semantic or syntactic errors.
- *Oral comprehension*: completely preserved.
- *Picture naming* and *repetition*: within the normal range both in English [4,5] and in Italian [6].
- *Spelling*: mild-to-moderate impairment in both English and Italian.

EXPERIMENTAL TASKS

Reading

CM's reading abilities were tested in both languages:
- in Italian with a reading task of 61 words and 30 nonwords
- in English with a reading task of 80 words and 24 nonwords (PALPA, tasks 31 and 36).

Word length, imageability and word frequency were considered in both languages; the Italian task also included a set of function words. The reading performance was analyzed both for accuracy (time limit = 2 secs) and for speed.

Lexical decision task

- English stimuli were taken from the PALPA (task 25);
  words were compared for imageability and word frequency.
- Italian words were also compared for grammatical class.

The exposure time of the letter strings was much shorter than the time required for an effective LBL reading strategy (500 mseconds, followed by a mask).

Semantic judgment task

The patient was given a list of words and asked to judge whether they belonged to a specific semantic category (animals, food, cloths).
The procedures and the timeline were identical to those used in the lexical decision task.

RESULTS (1)

Reading

CM's reading was slow and labored, with a clear length effect (she often had to write on the desk with her finger to retrieve the letters).
The pattern is consistent with an LBL reading impairment in both languages.

English

Accuracy. CM named 28% of the items correctly; imageability (55% vs 8%; Chi^2=14.52; p<.001), but not lexicality effect (31% vs 17%; Chi^2=1.95; p=.16, n.s.) were observed.

Reading Time. With no time limit, CM named 89% of the items correctly.
Performance was better on words than nonwords (93% and 79%), but the difference is barely significant (Chi^2=3.47; p=.06).
Consistent with the LBL reading behavior, the mean reading time was very long (8.0 secs).

Italian

Accuracy. CM named only 3% of the items within two seconds; this performance is significantly inferior to that obtained in English (Chi^2=21.39; p<.001).

Reading Time. With no time limit, a lexicality effect emerged (97% vs. 77%; Chi^2=9.07; p<.01); no imageability, frequency or grammatical class effects were found.
As in English, the mean reading time was very long (mean = 12.7 secs).
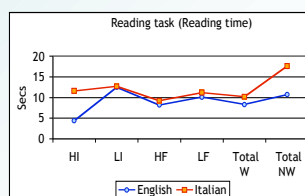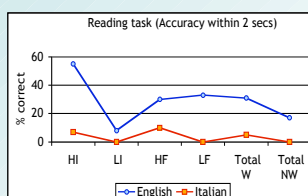
HI, high-imageability words; LI, low-imageability words; HF, high-frequency words; LF, low-frequency words; W, words; NW, nonwords.

RESULTS (2)

Reading time and length

Significant correlation between reading time and word length for both *Italian* nonwords (R^2= .476; p<.001), *English nonwords* (R^2=.471; p=.001) and *Italian words* (R^2=.199; p<.001); no correlation for *English words* (R^2=.004; p=.60, n.s.).
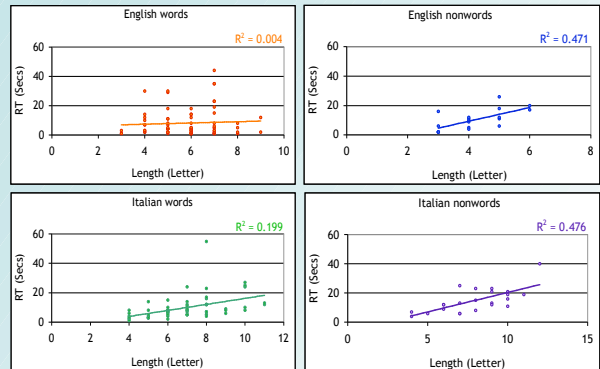

Lexical decision task

CM recognized 97% of the English words, rejected 65% of the English legal nonwords and 100% of the illegal nonwords (Chi^2 [df=2]=27.7; p<.001).

A similar pattern emerged in the Italian task where she identified 79% of the words, rejected 33% of legal nonwords and 100% of illegal nonwords (Chi^2 [df=2]=37.26; p<.001).
Italian function words were identified more poorly than concrete nouns (44% vs. 94%; Chi^2= 14.89; p<.001); a frequency effect was also observed in Italian (92% vs 69%; Chi^2=5.67; p<.05).

Semantic judgment task

CM misjudged only 5% of the English and 8% of the Italian items.
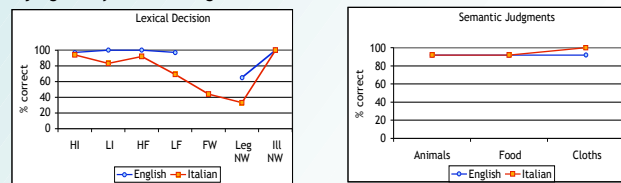
HI, high-imageability words; LI, low-imageability words; HF, high-frequency words; LF, low-frequency words; FW, function words; Leg NW, legal nonwords; Ill NW, illegal nonwords.

DISCUSSION

CM's behavior during the reading tasks suggests that she suffers from LBL dyslexia both in English and in Italian. Nonetheless, the performances, in both English and Italian, on the lexical decision and semantic judgment tasks unequivocally demonstrate that the patient was able to access implicit lexical and conceptual knowledge, even in the absence of any explicit word naming. The imageability effect observed in the English reading tasks with time limits also suggests an at least partial access to the lexicon; a further evidence in this direction is the lack of correlation between word length and the time necessary to read English words.

These findings are consistent with the assumption of residual RH reading abilities, which, however, allow for explicit reading only of English concrete words. The difference between CM's performances on the two languages may be due either to independent reading procedures for native vs. second language or to different reading mechanisms in languages with irregular or shallow orthographies; further evidence is necessary to disentangle these alternative hypotheses.

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ADDRESS FOR CORRESPONDENCE

Davide Crepaldi
Department of Psychology – University of Milano-Bicocca
Piazza dell'Ateneo Nuovo 1
20126 Milano - Italy
Phone: +39 2 64483775
Fax: +39 2 6448 3706
E-mail: davide.crepaldi@unimib.it