Applicability of dual-route reading models to Spanish

Alfredo Ardila[1] and Fernando Cuetos[2]
[1] Florida International University and [2] Universidad de Oviedo

Abstract

Two opposing points of view have been presented with regard to the applicability of the dual-route reading models Spanish. Some authors maintain that, given the transparency of the reading system, non-lexical reading is the strategy followed predominantly by Spanish readers and for that reason these models are not appropriate to explain alexias (acquired dyslexias) in Spanish. Other authors, consider that since several cases of phonological, surface and deep alexia have been reported, dual-route reading models are applicable to Spanish in the same way that to the irregular writing systems. In order to contrast these two points of view, an analysis of the two main factors that influence the reading is made: characteristics of the Spanish orthography and characteristics of the Spanish readers. It is conclude that, (1) Due to its transparency, non-lexical reading represents –as in other transparent orthographies-- the initial reading strategy in Spanish; (2) the "reading threshold" (i.e., time required to become literate) is lower in Spanish because there are no irregular words to learn; (3) as reading experience increases, speed increases and lexical reading becomes used more; (4) Given the characteristics of the Spanish reading system, it is understandable that frequency of deep dyslexia is so low.

Keywords: Reading models, transparent orthographies, reading learning, acquired dyslexias.

Resumen

Aplicabilidad de los modelos de lectura de doble ruta al español. Se han propuesto dos puntos de vista diferentes con relación a la aplicabilidad de los modelos de lectura de doble ruta al español. Algunos autores sugieren que dada la transparencia del sistema de lectura, la lectura no-léxica es la estrategia predominante en los lectores españoles, y esos modelos no son apropiados para explicar las alexias (dislexias adquiridas) en español. Otros autores consideran que, puesto que se han reportado varios casos de alexia fonológica, superficial y profunda en hispanohablantes, los modelos de doble ruta son aplicables al español. Para contrastar estas dos perspectivas se realizó un análisis de los dos principales factores que influyen en la lectura: las características del sistema ortográfico y las características del lector hispanohablante. Se concluye: (1) Dada su transparencia, la lectura fonológica representa la estrategia inicial de lectura; (2) el "umbral de lectura" (tiempo requerido para aprender a leer) es más bajo en español ya que no hay palabras irregulares; (3) a medida que aumenta la experiencia lectora, aumenta la velocidad y la lectura léxica se hace progresivamente más frecuente; (4) dadas las características del sistema de lectura español, es comprensible que la frecuencia con la que aparecen casos de dislexia profunda sea tan baja.

Palabras clave: modelos de lectura, ortografías transparentes, aprendizaje de la lectura, dislexias adquiridas.

Some disagreement exists regarding the applicability of the dual-route reading models developed in English (Coltheart, 1981; Ellis, 1984; Marshall, 1984; Morton, 1979) to Spanish. In these dual-route models of reading, two processes, or routes, are assumed to exist. For the so-called lexical procedure, the orthographic form is obtained directly by consulting the memory store, where representations of words are found. Through the non-lexical orthographic-to-phonological conversion procedure, each grapheme of the words is transformed into its corresponding sound. The first procedure can be used for familiar words, as well as to read irregular words, while the second one is used for unfamiliar words (Coltheart, 1981; Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001).

The applicability of these dual-reading models to Spanish has been controversial. Some authors have argued that, because

of the transparent orthography, lexical reading is not required in Spanish (Ardila, 1991; 1998; 2001, 2011; Ardila, Rosselli, & Ostrosky-Solís, 1996; Ardila, Rosselli, & Pinzón, 1989), and dual-route models are not appropriate to account for alexias (acquired dyslexias) in Spanish speakers. They proposed that semantic paralexias –that is, reading errors related to the meaning of the target word; for instance, to read "door" instead of "window"— and, in consequence, deep alexia, should be rather infrequent occurrences among Spanish speakers (Ardila et al., 1989; Ardila, 1991). These authors also suggested that "although Spanish reading proceeds using a graphophonemic strategy, additional strategies can also be introduced under special circumstances" (1998, page 885). This point of view is based on two observations: (1) due to transparency of the reading system, deep alexia (dyslexia) is not expected to occur in Spanish language reading, unless some logographic reading component were present (for example, when reading highly frequent logograms); furthermore, logographic reading is not required to read Spanish under normal conditions. These authors conclude that it would seem reasonable to assume that Spanish reading proceeds using a syllabic reading —syllable-by-syllable—system (Ardila, 1998; Ardila et al., 1996); (2) Clinical

observation of brain-damaged patients demonstrates that semantic paralexias are extremely unusual in Spanish (Lopera, 1987).

On the other hand, some other authors have argued that the dual-route models are applicable to Spanish reading, like it occurs in irregular orthographies. Their position is based on the results obtained in word naming experiments, where lexical-semantic variables, such as word frequency, imageability or age of acquisition, influence the reading latencies (Cuetos & Barbón, 2006; Davies, Barbón, & Cuetos, 2013; Wilson, Cuetos, Davies, & Burani, 2013). Additionally, the observation that acquired dyslexia cases congruent with the dual-route model of reading have been reported (Cuetos & Ellis, 1999; Ferreres & López, 2009; Iribarren, 2007). As a matter of fact, several cases of phonological (Cuetos, Valle-Arroyo, & Suárez, 1996; Ferreres, López, & China, 2003; Iribarren, Jarema, & Lecours, 1999), surface (Ferreres, López, & Fabrizio, 2012; Ferreres, Martínez, & Olmedo, 2005; Iribarren, Jarema, & Lecours, 1996), and deep dyslexia (Cuetos, 2002; Cuetos & Labos, 2001; Davies & Cuetos, 2005; Ferreres & Miravalle, 1995; Ruiz, Ansaldo, & Lecours, 1994) in Spanish language were reported in international literature. Therefore, if cases of phonological dyslexia, surface dyslexia and deep dyslexia are found in Spanish, then the dual-route model is applicable to Spanish.

There are a small number of reported cases with deep dyslexia published in Spanish. However, in all those cases, patients were described as having a high educational level. This data contrasts with English, where there are a large number of patients who made semantic errors. Landis, Regard, Graves, and Goodglass (1983) found, in an unselected sample of English-speaking individuals with aphasia who were not chosen according to any specific criterion, that over 50% (11 out of 20) presented one or several semantic paralexias in reading 36 words. It is interesting to note that, among their 11 patients with semantic paralexias, 4 presented a fluent aphasia, and 7 were of the non-fluent type. No doubt, semantic paralexias in the English language can be observed in a quite heterogeneous group of patients with aphasia, despite the fact that they are more frequently found in the nonfluent type of aphasia (Coltheart, 1980). Landis et al. (1983) concluded that, although semantic paralexias are produced in a lower rate by 'common aphasics' than by 'deep alexics', the fact that about one half of unselected patients with aphasia presented at least one paralexia indicates that semantic paralexias are actually a common phenomenon in English-speakers with aphasia. It is crucial to know that the concern of the applicability of dual-route models of reading is not restricted to Spanish, but has also been expressed in other languages with transparent orthographies (see Karanth, 2003). In fact, in Italian, another transparent orthographic system, cases of deep dyslexia are also scarce. Ciaghi, Pancheri & Miceli (2010) analyzed the reading of 340 aphasic patients in order to know the incidence of deep dyslexia. Only 9 patients—2.6% of the total—produced semantic errors, a percentage especially low if compared to the 75.3% presenting semantic errors in naming. In another large-scale study in Italian by Basso and Corno (1994), the incidence of deep dyslexia was only of 0.4%. A study of this type does not exist in Spanish, but the first author of this paper, in his life-long clinical experience with several thousand Spanish-speaking aphasics, has observed only two patients producing semantic paralexias when reading. Doubtless, the cases of deep dyslexia in Spanish could be considered exceptional.

In order to try to reconcile these contradictory points of view and understand whether deep dyslexia is rare in Spanish or in other languages, we will analyze the two points that can provide a response to that question: first, which are the characteristics of Spanish orthography? The second and most important, who is considered a reader of Spanish language? Answering these questions can be crucial not only for better understanding of the potential cross-linguistic communality in the brain organization of written language, but also for the development of remediation techniques in acquired language disturbances.

In this paper, a theoretical analysis of the applicability of the dual-route reading model to a language with a transparent orthography—Spanish—will be presented. Characteristics of Spanish orthography and Spanish readers will be emphasized. It will be suggested that the potential application of the dual route reading model to Spanish (and probably to other languages) is not a dichotomic issue ("yes" or "no"), but there is a crucial variable that has to be considered: the subject's reading experience.

Characteristics of Spanish orthography

Spanish orthography contains some differential peculiarities, especially if compared with English. The most crucial characteristic of the Spanish orthography is transparency, primarily in reading; that is, the orthography-phonology mapping is completely rule-governed across the language, although it is less transparent in writing (Cuetos, 1993).

A second important characteristic of Spanish its rhythm; Spanish is regarded as a "syllable-timed" language (Berg, 1991), whereas English is considered a "stress-timed" language (Dauer, 1983). It could be conjectured that this difference may be associated with an increased syllabic awareness in Spanish, potentially resulting in a tendency to read in a syllabic way. Perea and Carreiras (1998) found that words with high frequency syllables were pronounced quicker in word naming. Additionally, it has been found that the syllabic effect in reading is observed not only in reading words, but also pseudowords (Álvarez, Carreiras, & Taft, 2001; Álvarez, de Vega, & Carreiras, 1998). In addition, the syllabic structure is very simple in Spanish: 51.35% of the syllables are CV, 18.03% CVC, 10.75% V and 8.60% VC (Guerra, 1983). That means that 88.73% of the Spanish syllables have the combination CV, CVC, V or VC.

Noteworthy, words on average are shorter in English than in Spanish (Smith, 2012). The average number of letters in a Spanish word is 8.76, according to the dictionary of the Spanish Royal Academy of Language. Furthermore, 59.82% of Spanish words have between 7 and 10 letters. In fact, length is the most influential variable in word naming in Spanish (Cuetos & Barbón, 2006; Davies, Barbón, & Cuetos, 2013).

Another important characteristic is the greater number of inflectional categories-and affixes to mark them found in Spanish (Rubba, 2006). That simply means that morphology is more complex in Spanish than in English; words change according to the gender, number, etc, and several morphemes can be combined into a single word. Therefore, words on average contain more morphemes in Spanish than in English; a simple Spanish word such as *"leyéndolos"* ("reading them") contains four different morphemes.

As consequence to the characteristics of this language, Spanish reading is most efficiently taught through the phonetic and syllabic methods (Alegría, 1985; Cuetos, 1988). It is important to note that indeed the syllabic method is used most; the majority of Spanish

speaking children learn to read syllable by syllable. As a result, the early years of learning to read are dedicated to phonological recoding.

Characteristics of Spanish readers

Due to the transparency of the orthography and the simplicity of the syllables, native Spanish-speaking children learn to read very quickly, as it happens in other regular languages. Seymour, Aro and Erskine (2003) confirmed the strong effects that the orthography has on learning to read. Children from fourteen European countries who were in their first year of reading were chosen to read aloud a list of words and a list of nonwords. Children from transparent languages performed better than children from opaque orthographies. For instance, Finns, Greeks, Italians and Spanish children read 98%, 92%, 95% and 89% of the words respectively. However, Danes read 71% of the words and 54% of the nonwords and Scots only were able to read 34% of words and 29% of nonwords.

In addition, children from transparent languages are not only more accurate, but also faster readers. For that reason, Spanish-speaking children read increasingly efficient in comparison to child readers of more irregular writing systems (such as English or French) (Caravolas et al., 2012, 2013; Serrano et al., 2011). In general, it is assumed that one year of training is sufficient to learn the basic reading rules of Spanish (Seymour et al., 2003), whereas an irregular orthography such as English, takes notoriously longer to acquire a basic reading level (e.g., to read the newspaper). As pointed out by Cuetos and Suárez-Coalla (2009), when languages have irregular orthographies, children must learn to pronounce larger units (morphemes, or whole words) to achieve correct pronunciation.

Even though children achieve precise accuracy from the first year they begin to read Spanish, reading speed continues to improve throughout schooling and beyond. In several longitudinal and cross-sectional studies with Spanish children, it has been found that, after six years of learning, children continue improving their reading fluency. While good accuracy is attained quickly, facility and flow continue improving year after year (Castejón, González-Pumariega, & Cuetos, 2011; Cuetos & Suárez-Coalla, 2009).

Furthermore, the reading strategy in Spanish changes across the process of learning to read: Sanabria-Díaz et al. (2009) report that, whereas reading is initially phonologic/syllabic, as it progresses it becomes increasingly lexical—–global—(Sanabria-Díaz et al., 2009). Cuetos and Suárez-Coalla (2009) also support this finding: although initially Spanish speaking children use phonological reading, progressively, reading becomes more lexical. They used a large sample (409 children) corresponding to five age ranges (five- to 10-year-old children); they listed stimuli in which lexicality, frequency and length were manipulated, and presented to the participants. Number of hits (accuracy) and reading time (speed) were considered dependent variables. While the effects of frequency (lexical variable) increased with educational level (greater differences between high and low frequency words in the higher levels), the effects of length —sublexical variable— decreased (minor differences between long and short words). The authors concluded that reading acquisition in Spanish constitutes a continuum that ranges from phonological recoding to the use of lexical strategies, and that, for the most frequent words, this transition is made at an early stage. Numerous studies with

Spanish university students show that reading is influenced by lexical variables, such as word frequency and orthographic neighbourhood. They are even influenced by semantic variables such as imageability and age of acquisition (Cuetos & Barbón, 2006; Davies, Barbón, & Cuetos, 2013; Wilson, Cuetos, Davies, & Burani, 2013). But developing the lexical route requires time to incorporate word representations in the orthographic lexicon. In fact, it is a process that lasts a lifetime, because frequently, while reading, we find new words for which we have no lexical representation. According to the most popular hypotheses about the transition from sublexical to lexical reading, the Self-teaching hypothesis (Share, 1995), the first time we see a new word we have to use the sublexical route. But the repeated phonological recoding of that word offers the opportunity to acquire the orthographic representation.

Interestingly, most cases of deep alexia in Spanish have been reported in people with a very high level of education. The patient presented by Diaz (1995) was a scientific researcher. For at least two patients of Ruiz et al. (1994, Case 1 and Case 2) reading was one of their major premorbid activities. One patient was the author of several articles and books and the other studied Latin and Greek. Ferreres and Miravalles' (1995) patient spoke five different languages fluently. Cuetos's (2002) patient RM was a young psychologist, the same as JD, Cuetos and Labos's (2001) patient. MJ, the 38-year-old female patient with a high educational background, described by Davies and Cuetos (2005), worked as a secretary, a profession that usually requires continuous activity in reading and writing.

Many other patients with low level of reading experience encounter difficulties in reading but they do not produce semantic errors. This is the case of patient B (Davies & Cuetos, unpublished manuscript), a 61-year-old worker who suffered a stroke in the left temporal hemisphere. This patient presented expressive and comprehension problems with difficulties in reading, writing, aloud and naming impairment. Patient B had all the symptoms of deep dyslexia: he read 32% of the words but was unable (0%) to read nonwords. His performance was better with nouns (65%) than with verbs (36%), and much better than with function words (19%), but he did not produce semantic errors. Of the 246 errors he made with the 360 words, only in two cases could there be some doubt as to whether they were semantic errors: "*el mejor*" (the best) instead of "*bastante*" (enough) and "*tiempo*" —time, but also weather—instead of "*caliente*" (hot); although it was likely due to chance.

Discussion

Departing from the observations above it could be concluded that:

1. Due to its transparency, phonological reading represents —as in other transparent languages—the point of departure for a reading strategy in Spanish. As a matter of fact, Spanish-speaking children learn to read using a phonological approach because lexical or "global" reading is not required to read Spanish, as there are no irregular words. Noteworthy, this is not the case in English, because many English words, referred to as irregular words (i.e "yatch"), can only be read using the lexical route. Simply speaking, lexical reading is "mandatory" in English, but is only optional in Spanish.

2. Learning to read takes a longer time in English than in Spanish because of the irregularity of the system. The "reading threshold" is lower in Spanish, and people with one to four years of education can be regarded as readers of Spanish. These people would be regarded as illiterate or semi-illiterate in English because one to four years may be insufficient to learn to read English. Due to the regularity of the Spanish system, the reader does not have to learn how to read irregular words.

3. As reading experience increases, speed also increases and global reading, particularly for short and high frequency words, develops progressively. This means that lexical reading becomes more commonly used. Probably, short, high frequency words such as *casa* – house-, *mesa* – table-, *día* – day-, etc., are the first to have orthographic representation, whereas long low frequency words, such as *torniquete* –tourniquet-, *deambulación* – ambulation-, etc., are more likely to require the use of the phonological route. However, non-lexical versus lexical reading is not a mutually exclusive dichotomy; that is, that some words can be read using the lexical route, whereas other words can be read using the non-lexical route, but the majority of the words can potentially be read using both routes.

4. Given the characteristics of the Spanish reading system, it is understandable that frequency of deep dyslexia is so low, as it is limited to skilled readers who have managed to develop the lexical route.

Ultimately, in answering the departing question ("Are the dual-route reading models applicable to Spanish?"), it can be stated that, despite having a completely transparent orthography, Spanish speakers make use of a reading system that may include two routes working together, just as with opaque orthographies. But the use they make of each route is probably different from that of other languages. In general, the lexical route is used less in Spanish than in English, is as evident in the greater effects of lexical-semantic variables such as the age of acquisition and imageability in English, as well as the greater effects of the length —a sublexical variable— in Spanish (Cuetos & Barbón, 2006). Additionally, it depends on the type of word being read. For short words, formed by simple syllables and consistent grapheme-phoneme rules, such as *mesa* –table–, *pato* –duck–, the sublexical route may be more convenient. As recently stated by Traficante and Burani (2014), in the transparent orthographies, the sublexical route is not very demanding of resources, and skilled readers can use it in a highly efficient way. By contrast, for familiar words formed by complex syllables and/or context-dependent graphemes, such as *cristal* – crystal or, *agujero* – hole, the lexical route may be more useful. Moreover, it evidently depends on reading literacy and, thus, people with low level of reading experience mainly use the sublexical route, whereas skilled readers may prefer the lexical route. As observed, a significant percentage of Spanish readers have a complete reading system composed by the two routes individually used depending on the circumstances; occasionally, poor readers with few years of exposure choose the lexical way for reading very familiar words, and sometimes skilled readers use the sublexical route for unfamiliar words.

Acknowledgments

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