

**CAN ORTHOGRAPHIC KNOWLEDGE
MODIFY PHONOLOGICAL KNOWLEDGE?
DATA FROM A STUDY OF PORTUGUESE CHILDREN'S
SYLLABIFICATIONS AND THEIR RELATIONSHIP WITH
SCHOOLING**

Veloso, João, PhD
University of Porto – Faculty of Letters
Centre of Linguistics of the University of Porto
(Portugal)

In this study, we examine the relationship between orthographic knowledge and phonological knowledge. A group of 42 Portuguese children was screened during their first two years of schooling. Data suggest that children's exposure to orthographic rules modifies specific features of their phonological knowledge: /S/+Obstruent sequences are segmented preferably as homosyllabic at an early stage of schooling, but as heterosyllabic – in accordance with Portuguese orthography – after one year of formal learning of orthographic rules. This change is discussed here from the perspective of the homogeneity/heterogeneity debate and the permeability of the subjects' "knowledge of language" to cultural experience, two topics which Prof. Slama-Cazacu's work deals with very often.

Key words: Phonological knowledge; Orthographic knowledge; Schooling; Literacy; Homogeneity in language; Heterogeneity in language

1 – Homogeneity and heterogeneity in the study of language: the contribution of Tatiana Slama-Cazacu to the understanding of this dichotomy

Within the generative framework, based on some of the most important Chomsky's programmatic texts (see, a. o., Chomsky 1965, 1986), it is generally assumed that:

- (i) the very object of linguistics is a cognitive, internalised, abstract "state of the mind", the so-called "knowledge of language" (KL) (Chomsky 1986);
- (ii) KL is highly invariable from subject to subject. Speakers of a language are rather idealised as members of a completely homogeneous community (e. g., for a classic reference, Chomsky 1965:3)
- (iii) KL is deeply determined by genetic, innate, biological constraints;
- (iii) Therefore, KL is highly independent of any sociocultural variables or factors.

Viewed as a whole, these assumptions – in addition to others, also central in the theory – may be referred to, and will be referred to in the following pages, as the "homogeneity assumption".

Among the main contributions of Prof. Slama-Cazacu's scientific work is her criticism of this "homogeneity assumption"¹. In one of her most representative texts

¹ Let us remind now that the scientific establishment of linguistic disciplines such as sociolinguistics and pragmatics, for example, is partially due to this opposition to the generative homogeneity assumption

where this specific topic is dealt with, Slama-Cazacu (1977) clarifies her thoughts on the view of an ideal speaker-hearer² embedded in a purely homogeneous community. With respect to this matter, such an approach to language study is referred to as an “in vitro” perspective:

“Il est bien connu que, d’une part, la conception théorique et méthodologique de la linguistique chomskyenne a minimisé le rôle du milieu social et de la communication: l’énoncé étudié *in vitro*, en dehors du contexte de la communication, le locuteur/l’auditeur considérés comme des abstractions. (...) [Chomsky] visait l’«épuration» de la langue (...) des contingences de la réalité concrète, il tendait vers un rationalisme parfois à l’outrance, mais incompatible avec d’autres aspects de la théorie, vers la formalisation et les règles abstraites, pendant que tout son être était attiré par la psychologie, (...) et en fait par la vie sociale (...)”

(Slama-Cazacu 1977:183)³

2 – The effects of some sociocultural variables on language

Thanks to theoretical positions like the above-mentioned Slama-Cazacu’s (1961; 1972; 1977), a great amount of experimental work, namely in the 1970s and 1980s, underlined that KL is not a completely homogeneous reality, independent from the subjects’ sociocultural environment and circumstances.

In language acquisition, for instance, it was evidenced that many developmental features were correlated with a wide range of individual, cognitive and sociodemographic variables, such as social class, birth order, cognitive development and others (see, e. g.: Osser 1970; Cazden 1971; Ervin-Tripp 1971; Robinson 1971; Snow 1972; 1977a; 1977b; 1986; 1994; 1995; Brown 1977; Bates Bretherton & Snyder 1988:229-260; Pinto 1988; Mogford & Bishop 1993; Pine 1994; Richards 1994; Sokolov & Snow 1994; Gallaway & Richards eds. 1994; Bates, Dale & Thal 1995; Shore 1995)⁴.

In fact, it was demonstrated that, instead of following universal paths restricted by genetic constraints (as proposed by the generative approach), children acquiring a language followed different styles, highly dependent on cognitive and sociocultural variables, and showed important *individual differences* (Carroll 1979; Fillmore, Kempler & Wang 1979; Gilbert 1979; Lambert 1979; Leonard, Newhoff & Mesalam 1980; Bretherton, McNew, Snyder & Bates 1983; Vihman, Ferguson & Elbert 1986;

(see, for instance: Hymes 1971:6-7; Latraverse 1987:163 ff.; Fonseca 1994:96; Coupland & Jaworski 1997:5; Milroy & Milroy 1997:50).

² Another psycholinguist who has stressed the limitations of the approaches to language based on the homogeneity assumption is Prof. Maria da Graça Pinto. See, for example, Pinto’s (1994:12) words in favour of the necessity to study the “real speaker-hearer” instead of the Chomskyan, purely “ideal” one.

³ Other Prof. Slama-Cazacu’s texts, such as Slama-Cazacu (1961; 1972:22 ff.), emphasise this perspective, underlining the need for a scientific study of language that *contextualises* it within a social, interactive, cultural, *dynamic* environment. According to authors like Moerk (1994) and Scliar-Cabral (1994:26, 28), this is one of the main theoretical and methodological contributions of Prof. Slama-Cazacu’s achievements regarding the establishment of psycholinguistics as a science.

⁴ This kind of arguments fed the long-lasting debate known as “*nature/nurture debate*”, which evaluated the balance of innate vs. acquired factors in language acquisition (see Eysenck 1994:12, 68-71). In other words, it is a matter of how genetic vs. “epigenetic” (Danchin n.d.) factors interact in the acquisition process.

Goad & Ingram 1987; Vihman & Greenlee 1987; Bates, Bretherton & Snyder 1988; Ferguson 1989; Bates, Dale & Thal 1995; Shore 1995).

In domains other than language acquisition, research has shown that several other aspects of KL can be related to some sociocultural variables too.

One of the best known effects of this relationship lies in the work of the so-called “Brussels Group”, in the field of phonological awareness: thanks to relevant experimental work, it has been demonstrated that phoneme awareness – i. e., the awareness that words can be segmented into their constituting phonemes and manipulated taking these phonemes as a criterion – is shared only by literate subjects (see, among others: Alegria & Morais 1979; Morais, Cary, Alegria & Bertelson 1979; Alegria, Pignot & Morais 1982; Content 1985; Read, Yun-Fei, Hong-Yin & Bao-Qing 1986; Kolinsky, Cary & Morais 1987; Morais, Alegria & Content 1987; Bertelson, De Gelder, Tfouni & Morais 1989; Adrián, Alegria & Morais 1995; Morais, Kolinsky & Nakamura 1996; Scliar-Cabral, Morais, Nepomuceno & Kolinsky 1997; Morais, Kolinsky, Alegria & Scliar-Cabral 1998; Nakamura, Kolinsky, Spagnoletti & Morais 1998; Li, Anderson, Nagy & Zhang 2002; Miller 2002; Taylor 2002)

Accordingly, other works shed light on our understanding of this relationship, showing that orthographic knowledge – that is to say, the knowledge of the words’ spellings – extends its influence over a broad set of external manifestations of the subjects’ linguistic abilities and capacities, such as rhyme identification (Seidenberg & Tanenhaus 1979), sound detection (Ehri & Wilce 1980; Taft & Hambly 1985; Hallé, Chéreau & Segui 2000), sound categorisation (Ehri, Wilce & Taylor 1987), syllable segmentation (Treiman & Danis 1988; Ventura, Kolinsky, Brito-Mendes & Morais 2001) and phonemic transcription (Crookston 1999, 2001; Veloso in press).

All these evidences suggest then that KL is rather NOT the completely homogeneous entity proposed by the generative programme. If it were so, orthographic knowledge – a by-product of literacy⁵, i. e., the result of formal learning/schooling (thus the result of a cultural experience which is not shared by all speakers of all languages of the world) – could not show the just mentioned effects.

3 – The specific case of the syllabification of /S/+Obstruent sequences in European Portuguese: phonological description and orthographic conventions

In the following sections, we will concentrate on how the syllabification of /S/+Obstruent sequences in European Portuguese can illustrate some aspects related to the forementioned topics.

/S/+Obstruent sequences raise a considerable number of questions and problems when their syllabic status is discussed. Their interpretation either as homosyllabic (.CC) or heterosyllabic (C.C) is compatible with some phonological constraints but incompatible with other phonological constraints, as summarised by Table 1⁶ (see, for the application of such an analysis of the Portuguese CC clusters in general, Vigário & Falé (1994:476)).

⁵ “Literacy” is used here at its narrowest sense, i. e., as the ability to spell and to read written words. For a psycholinguistic enlarged discussion of this concept, see Pinto (1998:71 ff.).

⁶ For this reason, optimality theory (OT)-based approaches (see, a. o., Archangeli (1997) and Kager 1999) could be very useful in the study of these discrepancies from a purely phonological point of view.

Table 1 – Homosyllabic and heterosyllabic segmentation of CC sequences and their accordance with several phonological constraints⁷

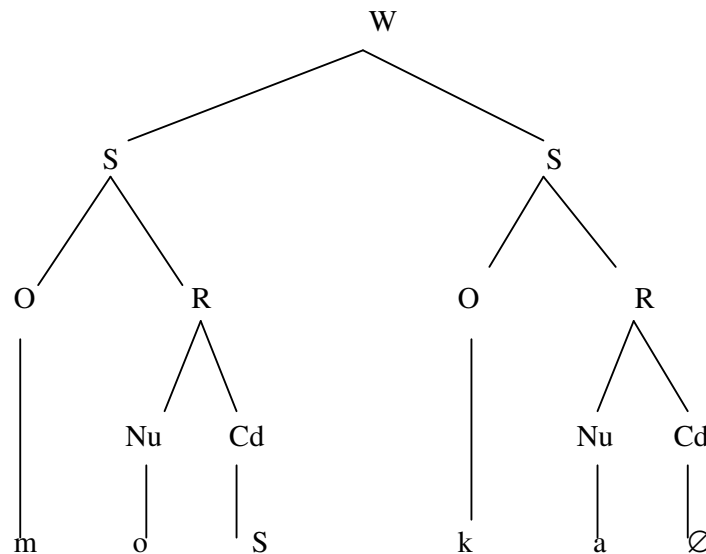
	Maximum Onset Principle	Sonority Principle	Dissimilarity Condition	Coda Restrictions
Homosyllabic (.CC)	OK	*	*	OK
Heterosyllabic (C.C)	*	OK	OK	*

OK = In accordance with principle; * = Not in accordance with principle.

As Parker (2002:8 ff.) points out, phonologists have proposed several, different arguments to explain the reasons why “clusters” such as /S/+Obstruent, even though they violate important syllabic constraints such as the Sonority Principle and the Dissimilarity Condition, are so often attested in many languages belonging to different language families. Such explanations, according to Parker (2002:9), range from the simple exceptionality embedded in the phonological component of grammar to the creation of empty nuclei, extrasyllabicity and the proposal of an “inverted affricate”⁸.

In European Portuguese, both the phonological descriptions of the language (see Mateus & D’Andrade (2000:60-64), for instance) and its orthographic rules assume these CC sequences as heterosyllabic, assigning the first consonant to the Coda position of a first syllable and the second one to the Onset of a second syllable, as displayed in Figure 1 (where the syllabic structure of “mosca” [‘moʃkɐ] ‘fly’ is analysed).

Fig. 1 – The syllabic analysis of a Portuguese word with a /S/+Obstruent sequence, according to current phonological proposals (e. g. Mateus & D’Andrade 2000)



⁷ Explanations of phonological constraints such as the Maximum Onset Principle, the Sonority Principle and the Dissimilarity Condition can be found in Selkirk (1984), Hogg & McCully (1987), Blevins (1995) and Mateus & D’Andrade (2000). Coda restrictions which apply in Portuguese phonology are described by Mateus & D’Andrade (2000).

⁸ For some other texts dealing with this problem on a phonological basis, see, among others, Durand (1990:209 ff.) and Kaye (1996).

However, some arguments can lead us to assume that the same /S/+Obstruent sequences may be represented in the speakers' phonological knowledge as homosyllabic. As seen earlier, this phonological interpretation is even legitimated by some phonological interpretations that do not coincide with the view that defines these CC sequences as always heterosyllabic (see Table 1). Other source of arguments in favour of other phonological interpretations lies in the first treatises of Portuguese orthography, such as Duarte Nunes de Leão's (1576:107), which postulates that these sequences are homosyllabic. An additional argument lies in some previous experimental studies (like Veloso (2002), for instance) which suggest that pre-school Portuguese children process certain phonetic sequences that occur word-initially as though they corresponded, at the phonological level, to "true" /S/+Obstruent clusters⁹.

4 – Experimental study

4.1 – Rationale and hypothesis

As reviewed in the previous paragraphs, there are explanations that support the interpretation of /S/+Obstruent sequences either as heterosyllabic or homosyllabic.

In section 3, we also saw that *modern* orthographic conventions establish these sequences as heterosyllabic, despite older ones, such as Leão's (1576), had proposed their homosyllabic status.

Line-breaking in written Portuguese is supposed to be strictly syllabic: a written word can be split into two different lines only at syllable boundaries. Accordingly, children are taught to break the written counterparts of /S/+Obstruent sequences as *s//consonant*. For this reason, words like "mosca" 'fly' and "cesto" 'basket' are always subject to the following line-breakings: *mos//ca*, *ces//to*.

As a consequence of these considerations, we hypothesised that in the phonological knowledge of subjects without any orthographic knowledge these sequences did not have any definite representation. Their representation as heterosyllabic would be a by-product of the orthographic knowledge, more precisely it should originate in the formal learning of line-breaking rules that impose the view of these sequences as heterosyllabic since they have to be broken following a pattern that associates /S/ with the Coda of a first syllable and the following obstruent with the Onset of a second syllable (see again the mandatory line-breakings at the end of the previous paragraph).

Thus, the experimental hypothesis of this study is the following one:

In the syllabification of medial /S/+Obstruent sequences, subjects before the formal learning of line-breaking rules do not apply an unique syllabic explicit segmentation; the partition of both consonants into two different, successive syllables (Coda+Onset) occurs only after the formal learning of such rules.

⁹ Veloso's (2002) data were obtained with words that begin, at the orthographic level, with a "e+s+consonant" sequence in which "s" is generally assumed to correspond to a /S/-Coda consonant (see Fig. 1).

To test this hypothesis, we developed a study whose main aim is to deepen our understanding of how orthographic knowledge – a sociocultural variable, as pointed out earlier – can determine or alter some precise points of the speakers' KL.

In addition to the intrinsic interest of such an effect, we underline here its relation to the main topic mentioned at the beginning of this paper, i. e., the permeability of KL to sociocultural variables in a broader sense.

More specifically, we took into consideration the effects of orthographic knowledge on the syllabic segmentation of words, in order to attain a better understanding of the relationship between orthographic knowledge and phonological knowledge¹⁰. Bearing this purpose in mind, we carried out the experimental study that will be presented in the following sections of this text.

The explicit syllabic segmentations of Consonant+Consonant (CC) sequences were then investigated. In this paper we will discuss the results obtained only with the specific case of /S/+Obstruent sequences¹¹.

4.2 – Methodology

4.2.1 - Population

42 children (21 male + 21 female), native, monolingual speakers of Portuguese participated in this study.

They attended three different public, state-run schools in the municipality of Maia, a few kilometers away from Portugal's second-largest city (Porto).

Generally speaking, the majority of these children came from a low/middle-class environment (fathers' mean schooling=8,73 school-years (SD=4,49 school-years); mothers' mean schooling=9,02 school-years (SD=4,83 school-years); 59,5% of these children came from low-income family backgrounds).

The mean age of the population was 6;11 years (SD=0;4 years) in the first session (last month of 1.st school-year), and 7;11 years (SD=0;4 years) in the second session (last month of 2.nd school-year).

4.2.2 – Procedure and linguistic material

Following the methodology observed by previous studies of children's metaphonological abilities (see, e. g.: Treiman & Zukowski 1991; Catts, Wilcox, Wood-Jackson, Larrivee & Scott 1997; Stackhouse & Wells 1997; Morais, Kolinsky, Alegria & Scliar-Cabral 1998:63; Taylor 2002), all the participant children were asked to break each word of the linguistic material into its constituting syllables.

First, the child was briefly explained that s/he should listen carefully to a word that the experimenter would present him/her. Then, s/he should break it into "small pieces" (metaphonological terms such as "syllable" were never used in the explanation given to the children). Each child was expected to articulate each syllable very slowly with a silent interval after each syllable so that the experimenter could identify the

¹⁰ It is then assumed here that phonological knowledge is part of the subject's knowledge of language (see, for instance, Burton-Roberts, Carr & Docherty 2000:2).

¹¹ The original study on which this paper is based is the author's PhD dissertation (Velooso 2003), which also dealt with other subjects not taken into consideration by the present paper.

syllable-breaks as well as possible as they were represented in the subjects' phonological knowledge.

Before the test session, a set of two or three words were segmented both by the child and the experimenter in order to get the child acquainted with the task s/he was supposed to perform on (the answers obtained in this pre-test were not validated).

Each child was observed twice: the first observation took place during the last month of the 1.st school-year, whilst the second one occurred during the last month of the 2.nd school-year. Each session – to collect not only the linguistic material presented in this paper but other items that will not be studied here¹² – lasted about 30 minutes. Both observations (first and second) were made in individual test sessions in the child's own classroom.

Since line-breaking rules are taught in the second year, the first observation was performed before children were explicitly and formally explained these rules. On the contrary, the second observation took place after they were already supposedly familiar with these rules.

All the children's answers were carefully recorded in phonetic transcription by the experimenter just after the child's answer.

Each word was presented by the experimenter, who articulated it carefully and tried to keep uniformity thanks to the phonetic transcription previously assigned to each single item of the linguistic material (see Table 2).

According to this methodological procedure, the children were asked to break the 5 words displayed in Table 2 into their syllables. All these words were assumed to enter the lexicon of the participant children.

Table 2 – Linguistic material used in the syllabic segmentation task

Portuguese word (*)	Phonetic transcription (**)	English correspondent
giná <u>st</u> ica	[ʒi'naʃtikø]	<i>gymnastics</i>
mos <u>ca</u>	[ˈmoʃkø]	<i>fly</i>
flore <u>st</u> a	[flu'rɛʃtø]	<i>forest</i>
ras <u>g</u> a	[ˈRaʒgø]	<i>[s/he] tears off</i>
cest <u>o</u>	[ˈseʃtu]	<i>basket</i>

(*) – The orthographic representation of the /S/+Obstruent sequence under analysis is underlined.

(**) – Each word was given a phonetic form which tries to correspond to its pattern realisation and to the realisation the experimenter tried to follow in the test sessions (departing from these phonetic transcriptions). Note that /S/ has two different, phonetic (allophonic) realisations in Portuguese: [ʃ] before a voiceless consonant and [ʒ] before a voiced consonant.

4.3 – Results

4.3.1 – First observation – End of first school-year

210 answers were obtained (=42 children X 5 words). However, due to different reasons (misarticulations and others) only 192 will be considered here.

Results are shown in Table 3.

Answers were categorised as homosyllabic when children assigned both consonants to a branching Onset of a single syllable (e. g.: [ˈmo.ʃkø] for “mosca” ‘fly’),

¹² See note 11.

as heterosyllabic when children licensed /S/ as the Coda of a first syllable and the following obstruent as the non-branching Onset of a second syllable (e. g.: [‘moʃ.kɐ] for “mosca” ‘fly’).

Table 3 – Homosyllabic and heterosyllabic segmentations of the /S/+Obstruent sequences in the first observation (end of first year)

HOMOSYLLABIC SEGMENTATIONS (*)		HETEROSYLLABIC SEGMENTATIONS (**)		TOTAL
N	%	N	%	N
102	53,1	90	46,9	192

(*) – Answers in which both consonants are licensed within the same syllable (branching Onset).

(**) – Answers in which the two consonants are split into two different syllables (1.st consonant as 1.st syllable Coda and 2.nd consonant as 2.nd syllable Onset).

The mean number of homosyllabic segmentations of the test words is significantly higher than the number of heterosyllabic segmentations (Wilcoxon test: $z=2,179$; $p<0,05$).

4.3.2 – Second observation – End of second school-year

The valid answers in this observation were 200. Results are displayed in Table 4.

The same criteria used in the analysis of the first observation results to tell homosyllabic and heterosyllabic segmentations apart (see above) were observed here.

Table 4 – Homosyllabic and heterosyllabic segmentations of the /S/+Obstruent sequences in the second observation (end of second year)

HOMOSYLLABIC SEGMENTATIONS (*)		HETEROSYLLABIC SEGMENTATIONS (**)		TOTAL
N	%	N	%	N
35	17,5	165	82,5	200

(*) – Answers in which both consonants are licensed within the same syllable (branching Onset).

(**) – Answers in which the two consonants are split into two different syllables (1.st consonant as 1.st syllable Coda and 2.nd consonant as 2.nd syllable Onset).

In this observation heterosyllabic segmentations are more frequent than homosyllabic ones. According to the Wilcoxon statistics, this difference is significant: $z=4,139$; $p<0,005$.

4.4 – Discussion

The rationale of this study had hypothesised that, before the formal teaching of line-breaking rules of Portuguese spelling, children would break /S/+Obstruent sequences in an inconsistent manner. According to the same rationale, after the learning of such rules the speakers' phonological knowledge would suffer a modification and subjects would analyse these sequences preferably as heterosyllabic.

As far as the first part of the rationale is concerned, the results seem agree with it only partially. Indeed, the results of the first observation (see Table 3) suggest that at the “naïf” status of the phonological knowledge of a native speaker of Portuguese – that is to say, in the stage of its formatting prior to the formal learning of the spelling rules –, /S/+Obstruent sequences are represented preferably as *homosyllabic*.

As for the second part of the rationale, our results seem to be more conclusive. Not only is the number of heterosyllabic segmentations of these sequences significantly higher than the number of homosyllabic segmentations, but also, when both observations are compared, there is a significant decrease of homosyllabic segmentations (Wilcoxon test: $z=3,933$; $p<0,005$) and a significant increase of heterosyllabic segmentations (Wilcoxon test: $z=4,313$; $p<0,005$).

In sum, there seems to be a *progressive conformation* of the subjects' internal phonological knowledge to the orthographic rules that are taught during the schooling process. The teaching of these rules, contrarily to what could be thought of, does not confine its consequences to the subjects' spelling performance: as a matter of fact, it seems to extend its effects to their very phonological knowledge itself.

An explanation for the subjects' clear preference for syllabifying these sequences as homosyllabic in the first observation (Table 3) – contrarily to the rationale that hypothesised that no clear preference would be identified at this early stage – has not been found indeed. Nevertheless, it reinforces our main conclusion: the learning of spelling rules can alter the state of the subjects' phonological knowledge. As our results may suggest, this learning can, within the span of a school-year only, “redirect” the shape of phonological knowledge entirely towards its opposite direction.

It has to be said that the syllabification of consonant groups is not a matter of minor importance in the phonology of a language¹³. That is to say, this apparent interference of cultural experience cannot be strictly limited within the secondary chapter of “peripheral grammar”, the only level where the most orthodox version of the homogeneity assumption admits the existence of such an influence (see, for example, Chomsky 1981:126-127).

Beyond the intrinsic interest of such data, this presumable effect of schooling on the phonological knowledge of subjects has two different implications which appear to be very important for the purpose of this study:

- on the one hand, it enlarges our understanding of how literacy can interfere with phonological knowledge, going farther than the exploration of some “classic” effects like the ones that were mentioned in section 2;
- on the other hand, as a consequence of it, this kind of results may emphasise the assumption that one's internal knowledge of language is *not* completely independent of sociocultural variables (such as the experience of schooling).

¹³ Actually, it inspires a major debate among phonologists (see, for example, Blevins 1995:232).

5 – FINAL REMARKS

The main conclusion that can be drawn from these results is that knowledge of language does not seem to be really independent from certain sociocultural variables¹⁴.

Consequently, the speakers' internal grammar cannot be conceived of as a purely homogeneous reality, unanimously shared by all members of a community regardless of each one's own personal experiences. That is to say, a balance between homogeneity and heterogeneity has to be found by those who approach language as a scientific object of study.

Among the endeavouring scientific contributions that led us to this way of looking at this problem, the work of Prof. Tatiana Slama-Cazacu cannot be neglected. Thanks to her effort to *contextualise* the study of human language, in a sense that diverges from the "mainstream" homogeneity assumption, our vision of language has become enriched and empowered.

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¹⁴ In this paper, we dealt with a "level" of linguistic knowledge only – phonological knowledge. Departing from here, it seems acceptable that other similar effects could have been found at its other levels (syntactic or semantic knowledge, for instance). Concomitantly, we dealt with one single sociocultural variable – schooling – but similar effects could be seemingly identified with other variables, like, for instance, the ones mentioned in section 2.

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