Cognition 127 (2013) 398–419

Contents lists available at SciVerse ScienceDirect

Cognition

journal homepage: www.elsevier.com/locate/COGNIT

Phonological development in relation to native language and literacy: Variations on a theme in six alphabetic orthographies

Lynne G. Duncan [a,*], São Luís Castro [b], Sylvia Defior [c], Philip H.K. Seymour [a], Sheila Baillie [a], Jacqueline Leybaert [d], Philippe Mousty [d], Nathalie Genard [d], Menelaos Sarris [e], Costas D. Porpodas [e], Rannveig Lund [f], Baldur Sigurðsson [g], Anna S. Þráinsdóttir [g], Ana Sucena [b], Francisca Serrano [c]

[a] School of Psychology, University of Dundee, Dundee DD1 4HN, United Kingdom
[b] Centro de Psicologia, Faculdade de Psicologia e Ciências da Educação, Universidade do Porto, 4200-135 Porto, Portugal
[c] Faculty of Psychology, Universidad de Granada, 18071 Granada, Spain
[d] Centre for Research in Cognition & Neuroscience, Laboratoire Cognition Langage & Développement, Université libre de Bruxelles, B-1050 Brussels, Belgium
[e] Section of Psychology, Department of Education, Faculty of Humanities and Social Sciences, University of Patras, 26504 Patras, Greece
[f] Reykjavik Academy, 107 Reykjavik, Iceland
[g] School of Education, University of Iceland, 105 Reykjavik, Iceland

ARTICLE INFO

Article history:
Received 29 July 2010
Revised 11 February 2013
Accepted 16 February 2013
Available online 29 March 2013

Keywords:
Phonological awareness
Orthographic depth
Speech rhythm
Cross-linguistic
Reading development
Phonics instruction

ABSTRACT

Phonological development was assessed in six alphabetic orthographies (English, French, Greek, Icelandic, Portuguese and Spanish) at the beginning and end of the first year of reading instruction. The aim was to explore contrasting theoretical views regarding: the question of the availability of phonology at the outset of learning to read (Study 1); the influence of orthographic depth on the pace of phonological development during the transition to literacy (Study 2); and the impact of literacy instruction (Study 3). Results from 242 children did not reveal a consistent sequence of development as performance varied according to task demands and language. Phonics instruction appeared more influential than orthographic depth in the emergence of an early meta-phonological capacity to manipulate phonemes, and preliminary indications were that cross-linguistic variation was associated with speech rhythm more than factors such as syllable complexity. The implications of the outcome for current models of phonological development are discussed.

1. Introduction

While the impact of variation between languages on orthographic development has been documented in several large-scale studies (Caravolas et al., 2012; Ellis et al., 2004; Seymour et al., 2003; Ziegler et al., 2010), phonological development has yet to receive the same degree of attention in cross-linguistic research. One consequence of this is that understanding of phonological development in relation to early reading is informed by a predominantly English-language literature with all the disadvantages entailed by over-reliance on what is acknowledged to be an atypical orthography (Share, 2008). Of course, many notable studies on languages other than English exist; indeed, seminal work on phonological awareness was conducted using the Germanic languages of Scandinavia (Lundberg, Frost, & Petersen, 1988; Lundberg, Olofsson, & Wall,

* Corresponding author. Address: School of Psychology, University of Dundee, Dundee DD1 4HN, United Kingdom. Tel.: +44 (0)1382 384629; fax: +44 (0)1382 229993.
E-mail address: l.g.duncan@dundee.ac.uk (L.G. Duncan).

0010-0277/$ - see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.cognition.2013.02.009

1980). Nevertheless, few studies have systematically compared phonological development between two languages in order to understand the interaction between native language and progress, and none to our knowledge have made observations cross-linguistically and longitudinally from the point when spoken language determines phonological awareness until increasing experience of the written orthography begins to influence further development. Thus, the present study is unusual in both scale and duration, as it encompasses six European languages with alphabetic orthographies and uses a carefully-matched methodology to compare phonological development during the first year of reading acquisition.

A detailed review of the literature follows this section. The theoretical questions under investigation concern competing views about the nature of phonological development. From one perspective, development is seen as a universal sequence of increasing sensitivity to smaller units of sound as a result of the changing organisation of speech representations during language acquisition. However, other views predict more variability in the sequence of development according to the characteristics of the specific language context and whether implicit or explicit learning about sound is examined. The questions are timely, having important implications not only for understanding the development of the phonological system but also for modelling early visual word recognition (Grainger, Lété, Bertrand, Dufau, & Ziegler, 2012; Ziegler & Goswami, 2005), where the phonological lexicon is regarded as integral to the orthographic learning process.

The data will show that the idea of a universal fixed sequence of development is an unnecessary constraint on thinking in this area. Instead, our experiments will reveal a dynamic process that responds to the influences of native language, task demands and instructional context. Surprisingly, the phonological awareness literature has not always embraced such factors perhaps due to the combination of an anglocentric bias and a strong theoretical focus on the *size* of the sounds that are important in early reading.

1.1. Competing views of preschool phonological development

The relation between phonology and orthography in reading development is most likely bi-directional (e.g., Perfetti, Beck, Bell, & Hughes, 1987; Wagner, Torgesen, & Rashotte, 1994). A necessary first step in uncovering the fine details of this relationship between phonology and orthography then is to describe the availability of sound as reading acquisition begins and whether this differs notably between languages. What would be considered "atypical" is particularly important since delay or impairment to the availability of early phonological skills is detrimental to subsequent reading progress (Carroll & Snowling, 2004).

Phonological development is characterised as a large-to-small sequence in the *Lexical Restructuring* (LR) model (Metsala & Walley, 1998; Walley, 1993). The basis of this model is that the need to distinguish an increasing variety of words in the developing lexicon causes recursive change, known as *lexical restructuring*, in the early organisation of the speech system. Spoken words are initially represented as unanalysed wholes with the result that attributes such as global acoustic or prosodic structure are used for recognition. As the lexicon begins to expand significantly with the vocabulary growth spurt around the age of 18 months, there is an increased need for more fine-grained sub-lexical representations to facilitate discrimination between similar lexical entries. Lexical representations, initially based around syllables, are gradually overlaid with segmental information and cross-referenced with existing members of similarity neighbourhoods to produce efficiencies in storage and recognition. Nevertheless, children's speech processing is thought to remain more holistic than that of adults throughout middle childhood in spite of the increasingly segmental organisation in long-term memory. For example, children aged between 4 and 5 years still make syllable similarity classifications based on global similarity rather than using phonemic similarity as favoured by adults (Treiman & Baron, 1981; Treiman & Breaux, 1982).

Thus, the LR model gives rise to several key claims: (1) lexical restructuring alters the structure of speech representations from a holistic to a segmental format (i.e. a large-to-small sequence); (2) lexical restructuring is vocabulary-driven and occurs first for items that are acquired early, are high in frequency and are from dense neighbourhoods; (3) early (implicit) sensitivity to phonemes in spoken word recognition is the product of this process of segmental restructuring; (4) emerging phoneme awareness, an explicit ability, depends on this aspect of "language development specifically, rather than on general metacognitive ability or reading experience" (Metsala & Walley, 1998, p. 108); and therefore, (5) implicit and explicit performance will be related for specific items.

Some variants of the LR view exist with several authors specifying that large-to-small restructuring follows the proposed hierarchical internal structure of the syllable (Selkirk, 1982). Instead of the syllable-to-phoneme sequence envisaged in the LR model, this would create a path from a syllabic to an intermediate level of organisation, which emphasises the onset (i.e. the initial consonant(s)) and the rime (the vowel plus any following consonants), before finally settling at the phonemic level (e.g., Ferguson & Farwell, 1975; Jusczyk, 1986). The *Psycholinguistic Grain Size* (PGS) model of reading development (Ziegler & Goswami, 2005; Ziegler, Perry, Jacobs, & Braun, 2001) predicts that preschool restructuring will only create a progression from syllable to onset-rime awareness and that further progression to the phoneme level will not occur until reading begins (see also Goswami (2002)). Finally, while the LR model portrays the restructuring sequence as universal, the PGS model acknowledges the possibility of cross-language variation on the basis of the characteristics of spoken language such as the prevalence of phonological rime neighbourhoods. Variation is limited at present to differing *rates* of phonological development among European languages as opposed to the possibility of differing *sequences* of development (see also Anthony & Francis, 2005).

An alternative account contained within a more general model of *meta-linguistic* (ML) development, referred to here as the ML model, contrasts with this position in a number of ways (Gombert, 1992; Karmiloff-Smith, 1986).