



## Comprehension of texts by deaf elementary school students: The role of grammatical understanding



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### ABSTRACT

**Background:** The aim of this study was to analyze how the reading process of deaf Spanish elementary school students is affected both by those components that explain reading comprehension according to the *Simple View of Reading model*: decoding and linguistic comprehension (both lexical and grammatical) and by other variables that are external to the reading process: the type of assistive technology used, the age at which it is implanted or fitted, the participant's socioeconomic status and school stage.

**Design:** Forty-seven students aged between 6 and 13 years participated in the study; all presented with profound or severe prelingual bilateral deafness, and all used digital hearing aids or cochlear implants. Students' text comprehension skills, decoding skills and oral comprehension skills (both lexical and grammatical) were evaluated.

**Results:** Logistic regression analysis indicated that neither the type of assistive technology, age at time of fitting or activation, socioeconomic status, nor school stage could predict the presence or absence of difficulties in text comprehension. Furthermore, logistic regression analysis indicated that neither decoding skills, nor lexical age could predict competency in text comprehension; however, grammatical age could explain 41% of the variance. Probing deeper into the effect of grammatical understanding, logistic regression analysis indicated that a participant's understanding of reversible passive object-verb-subject sentences and reversible predicative subject-verb-object sentences accounted for 38% of the variance in text comprehension.

**Conclusions:** Based on these results, we suggest that it might be beneficial to devise and evaluate interventions that focus specifically on grammatical comprehension.

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### What this paper adds

This article examines the text comprehension abilities of 47 deaf Spanish elementary school pupils aged 6–13 years. The study identified grammatical comprehension of spoken language as a key predictor of performance in reading comprehension differentiating it from the other variables tested, namely: decoding skills, lexical age and demographic variables. Further analysis identified that good reading comprehension was associated with understanding of two specific grammatical structures: reversible passive object-verb-subject (OVS) sentences and reversible predicative subject-verb-object (SVO)

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sentences. These findings suggest that specific interventions targeting grammatical constructions may pave the way to improving reading comprehension in deaf children.

## 1. Introduction

Mastery of reading is one of the fundamental core competencies of elementary education. Many research studies have demonstrated that the reading performance of deaf students is significantly lower than that of their hearing peers (Allen, 1986; Conrad, 1979; Marschark & Harris, 1996; Moreno-Pérez, Saldaña, & Rodríguez-Ortiz, 2015; Pérez & Domínguez, 2006; Perfetti & Sandak, 2000; Torres & Santana, 2005). This remains true in spite of advances in audiology during the last 20 years, which have significantly improved the prognoses for development and learning in deaf students. The early detection of hearing difficulties is now far more widespread and the advancements in both electro-acoustic and programmed technologies that have been applied to cochlear implants (CIs) and digital hearing aids (HAs) have improved both devices (Salesa, 2012), allowing many deaf children to achieve functional hearing. Following several decades of use of both these devices, it can now be observed in the present generation of deaf students that while many of their competencies are significantly better than those of previous generations, these students still lag behind their hearing peers in several areas. Lederberg, Shick, and Spencer (2013), in their review of advances and limitations in oral and written language development among deaf children, noted that many of these children exhibit a particular weakness in grammatical development, and this weakness has a cascading effect on both reading and writing. Lederberg et al. (2013) concluded that the average reading skills of deaf children of the present generation, while higher than those previously recorded, still lagged behind their hearing peers. In addition, these deaf children continued to exhibit the large inter-individual variations previously noted. While it seems clear that HAs and CIs have provided deaf children with better access to sound, their use has not necessarily resulted in normal language development to any widespread degree. This study analyzes those variables that predict a higher level of reading comprehension among deaf students thereby gathering useful data for intervention in cases of reading difficulties. The aims of this study are to evaluate the reading skills of deaf Spanish elementary school students and to analyze the factors that are associated with a higher or lower level of reading ability. In Spain, elementary education consists of 6 courses, organized in three stages, for students from 6 to 12 years of age.

A review of existing literature on reading and deafness noted that the majority of studies had been conducted on English-speaking populations. We identified two groups of variables that explained inter-individual differences in the reading performance of deaf students. One group are external to the reading process (use of CIs or HAs, age at the time of fitting or activation, family socioeconomic status and chronological age), the other group are internal (decoding, lexical comprehension and grammatical comprehension).

The use of CIs in preference to conventional systems is one factor that several studies have demonstrated improved reading outcomes in children when compared to conventional aids (Archbold et al., 2008; Connor & Zwolan, 2004; Domínguez, Pérez, & Alegría, 2012; Geers, 2003, 2006; Geers, Nicholas, & Sedey, 2003; Johnson & Goswami, 2010; Kyle & Harris, 2006; Nicholas & Geers, 2008; Spencer, 2004; Vermeulen, Van Bon, Schreuder, Knoors, & Snik, 2007; Watson, Archbold, & Nikolopoulos, 2006). Other recent studies, however, have found no such difference between children with severe or profound hearing loss who use CIs and those with severe hearing loss who use digital HAs (Cupples, Ching, Crowe, Day, & Seeto, 2014; Fitzpatrick et al., 2012; Harris & Terleksi, 2010; Szterman & Friedmann, 2014).

Another factor proposed to explain the variation among deaf children who use CIs is the age at time of fitting or activation. Many studies have demonstrated that early fitting has a significant positive effect both on linguistic development (Caselli et al., 2012; Manrique et al., 2004; Nicholas & Geers, 2007, 2008) as well as on reading performance (Connor & Zwolan, 2004; Johnson & Goswami, 2010; Spencer & Oleson, 2008). A longitudinal research study conducted by Geers and Nicholas (2013) demonstrated high levels of language and literacy development in deaf children who were fitted with CIs at an early age. It was also observed that vocabulary-related skills are more easily acquired by deaf children than grammar skills.

Family socioeconomic status has also been identified as a possible explanation for the inter-individual differences observed in the reading performance of deaf students. Geers (2006) identified improved performance in deaf children whose parents had a higher socioeconomic status, and in a subsequent longitudinal study, Geers and Nicholas (2013) acknowledged that the high performance recorded in deaf children who participated in their study might be related to the high socioeconomic status of their families, which was higher than that of the general population.

In addition to the aforementioned factors, the possibility that the differences in reading achievement reported across studies may be related to the age of the participants cannot be omitted. Lags in reading development in children with hearing loss tend to widen with age (Geers & Hayes, 2011; Kyle & Harris, 2010; Kroese, Lotz, Puffer, & Osberger, 1986; Marschark & Harris, 1996). In their longitudinal study of the development of deaf children in school, Geers, Tobey, Moog, & Brenner, 2008 demonstrated that, after 5 years using a CI, students displayed good reading performance while 7 years after first using the implant all of the students exhibited below average performance. Early and more recent research studies (Conrad, 1979; Karchmer & Mitchell, 2003) have shown that the average reading age of deaf adolescents is 9 years.

Considering those variables that are internal to the reading process, given the breadth of competencies that reading ability encompasses, it is to be expected that reading difficulties may arise from different factors. The Simple View of Reading model (Gough & Tunmer, 1986; Hoover & Gough, 1990), which sets the context for the present study, proposes that reading skills are the product of both decoding ability and linguistic comprehension. Implicit in decoding is the ability to rapidly translate a printed word into a representation that encapsulates the meaning of that word. As Hoover and Gough (1990) state, when

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