# Supporting deaf children's reading skills:
# the many challenges of text simplification

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## ABSTRACT

Deaf children have great difficulties in written comprehension. In our contribution, we illustrate how we have collected and simplified some stories in order to render them suitable for young Italian deaf readers. The experimental data demonstrate that the approach is effective and that enriching the stories with static and/ or animated drawings significantly improves text readability. However, they also clearly point out that textual simplification alone is not enough to meet the needs of the target group and that the story structure itself has to be carefully planned..

## Categories and Subject Descriptors

H.5.2 [**User Interfaces**]: Natural language, Graphical User Interfaces.

## General Terms

Experimentation.

## Keywords

Deaf children, text simplification, reading comprehension.

## 1.INTRODUCTION

Deaf children may have substantial literacy difficulties [1]. This condition is also due to the type of educational intervention they are faced with, which accustoms them to decoding single words and isolated sentences, rather than entire texts, thus making it difficult to gain an overview of the whole plot [2]. We have developed a software literacy tool, called LODE [3], for supporting deaf children in improving their reading comprehension skills in Italian. The child using LODE will read an entire story and then do a series of comprehension exercises which should help him/her to reason on the read text in its totality. To favour the child's focusing on the inference aspect and not on other factors involved in the reading comprehension skills [4], LODE proposes stories which have been previously simplified by experts. In the present contribution, we describe the steps we undertook to select the stories to be published in LODE and how we simplified them on the basis of our target group's needs. Moreover, we discuss the results of an evaluation conducted in spring 2011 with deaf children aged 8 to 14

## 2.LITERACY AND DEAF CHILDREN

The term literacy refers to the ability to read and write at a level that lets one understand and communicate ideas in a literate society. Learning to read and write is extremely difficult for deaf children because these activities are based on verbal language, which is definitely not deaf people's first language. With regard to the reading ability of deaf children, they have problems with at least three levels of comprehension: lexical, morphological and inferential. At lexical level, they generally have a vocabulary limited to a few words and they tend to connect the meaning to the context, having difficulties in generalizing it [5]. They often fail in detecting the meaning of idiomatic expressions, metaphors and allegories [6]. Moreover, intuitiveness generally helps to deduce the meaning of an unknown word from the context, resorting to personal experience. While they share the much of the same experience as hearing people, deaf children cannot rely on similar word knowledge. Some studies affirm that deaf pupils' education tends to focus on reading and writing tasks based on single sentences, so that the ability to infer information from the text itself develops with difficulty [7,8]. Information technology (IT) techniques are a great resource for those who work with deaf children. Characteristics such as high memory capacity, visualization abilities, hyperlink techniques as well as sophisticated artificial intelligence techniques can be used to build new effective educational tools able to improve this situation. For this reason, we worked on LODE. In the following sections, we will describe how the stories proposed in LODE have been chosen and modified adapting them to the special users considered, deaf children aged 8 to 14.

## 3.THE LODE'S STORIES

There are two main aspects to be considered when looking for stories to be read by deaf children. First, stories should attract children's attention to help them maintain their concentration on what they are reading. Deaf children are tendentiously untrained readers and get bored quickly, therefore the text's appeal becomes vital to keep their attention high. Second, stories should be suitable for the children's literacy levels. Indeed, too easy a story may bore the reader whereas a too difficult one may be frustrating. Both aspects relate to the children's age and literacy level which do not correlate linearly. In fact, it is not infrequent that a deaf pre-adolescent is less literate than a younger child. To create the LODE's database of stories, we followed a four-step procedure: (1) we looked for suitable stories, (2) we annotated on the original version of each chosen story, (3) we simplified all the texts, reducing number of subordinate clauses, of (multiple) pronouns and of clitics etc. and substituting those words that are not included in the "Lessico elementare"[9] with synonyms, and

(4) we classified and stored them in an electronic repository. The four steps are described in detail in [10].

## 4. STORIES' EVALUATION

To check if the LODE's stories are comprehensible to deaf children, we performed a test involving eighteen deaf children, ten aged 8 to 11 (this group is indicated with yD in the following) and eight aged 12 to 14 (oD), and twelve hearing children, eight aged 8 to 11 (yH) and four aged 11 to 14 (oH), as a control group. The aim of our test was to verify if the simplification operations we conducted on the stories have rendered the story texts easier to read and more understandable for our target group. We also aimed to test the effectiveness of using static and animated drawings to improve the readability of the simplified stories. An example of this type of story presentation is shown in Figure 1: when the child opens the page, he/she only sees the background image. Moving around the mouse, the user activates an animation; when clicking on it, the story text appears. Words with the yellow background are active words, i.e. they are linked to a dictionary proposing a textual definition, an example of use, an image and a video with the translation in Italian sign language (LIS).

Each child read three stories selected according to their age/class attended in the following progression: a story in its original version, a story simplified as explained above, and a simplified story illustrated with drawings and definitions. After reading each story, the child answered the eleven questions foreseen for the comprehension exercises. A statistical analysis of the percentage of correct answers given shows that there is a significant difference among the responses to the sets of exercises related to the three types of stories only in the yD group ($F_{(330, 2)} = 6.740$; $p < .001$), but not in the oD group ($F_{(264, 2)} = 2.143$; $p=.119$). In both cases there is an improvement of the correct answer rate from the original story to the simplified version with drawings. Nevertheless, in the oD group the difference between the mean of correct answers given to the original story and the one relative to the simplified story is almost inexistent. Moreover, in the yD group the mean of correct answers to the simplified story without images is lower than the one achieved in the exercises to the other two story types. We employed a parametric ordinary linear regression model (ANOVA) to compare and contrast the mean differences between the deaf and hearing children's scores, in order to show the eventual influence of the instrument itself (the stories) and the target group(s) for which it was meant. The results underline that there is a significant difference among the three stories and that the third one always appears to be the most comprehensible for deaf children.

The analysis shows that the stories meant for the older children (11-13) do follow the pattern we had intended (from the original, more difficult story to the simplified-illustrated, easier one) and that the slightly (though non significantly) better performance of the hearing children does not depend on the type of the stories at all. As regarding the test's goals, we have verified that the simplified story with drawings and definitions is the most comprehensible for both yD and oD groups. Given these results we can also state that text simplification helps children to easily understand a story but, unfortunately, we cannot draw any firm conclusions about the simplification impact for the first, younger group, though the comparison with the control group's results do speak in favor of text simplification. Clearly enough, lexical and syntactic simplification alone is not sufficient to guarantee for the readability of a text by a deaf readership. The story's structure itself (event sequence, length etc.) has to be carefully designed in order to avoid confusion and boredom in the deaf reader.

## 5. CONCLUSIONS

The background, the process and the experimental data we have illustrated show that providing suitable stories for deaf children is in no way a simple task. The parameters and the factors to be managed and to kept under control are diverse and numerous and reside in the target group's specifics – i.e. their specific needs - but also in the stories themselves – i.e. plot, climax -. Nonetheless, we have shown that though it might be challenging, it is possible to offer deaf children captivating stories they can easily understand and enjoy.
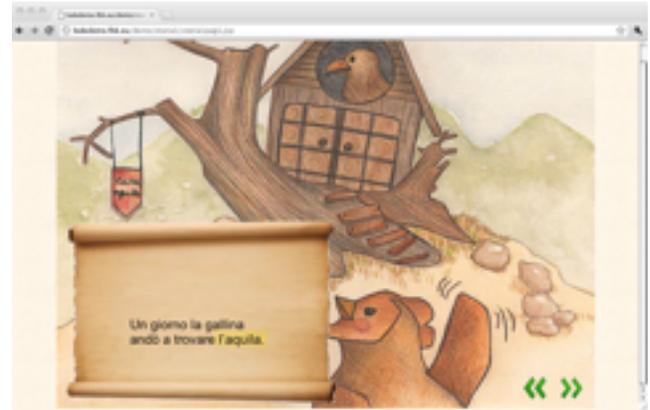


**Figure 1. The simplified illustrated story: an example of an animated drawing.**

## 6. REFERENCES

[1] Wauters, L.N., van Bon, W.H.J. and Tellings, A.E.J.M. 2006. Reading Comprehension of Dutch Deaf Children. *Reading and Writing*. 19, 49-76.

[2] Banks, J. and Gray, C. and Fyfe, R. 1990. The Written Recall of Printed Stories by Severely Deaf Children. *British Journal of Educational Psychology*. 60, 192-206.

[3] Gennari, R. and Mich, O. 2007. Constraint-based Temporal Reasoning for E-learning with LODE. In *Proceedings of the 13th International Conference on Principles and Practice of Constraint Programming* (2007).

[4] Whitehurst, G. and Longian, C. 1998. Child Development and Emergent Literacy. *Child Development*. 69, 848-872.

[5] Fabretti, D., Volterra, V. and Pontecorvo, C. 1998. Written Language Ability in Deaf Italians. *J. of Deaf Studies and Deaf Education*. 3(3), 231-244.

[6] Rittenhouse, R K. and Stearns, K. 1982. Teaching Metaphor to Deaf Children. *American Annals of the Deaf*. 127(1).

[7] Arfé, B. and Boscolo, P. 2006. Causal Coherence in Deaf and Hearing Students' Written Narratives. *Discourse Processes*. 42(3), 271-300.

[8] Wilbur, R.B. 2000. The Use of ASL to Support the Development of English and Literacy. *J. of Deaf Studies and Deaf Education*. 5, 81-104.

[9] Marconi L., Ott M., Pesenti E., Ratti D. and Tavella M. 1993. Lessico Elementare. *Dati statistici sull'italiano letto e scritto dai bambini delle elementari*. Bologna: Zanichelli.

[10] Mich, O. and Vettori, C. 2011. *E-Stories for Educating Deaf Children in Literacy. The DAMA Procedure*. FBK Tech. Report.