Matilda: A Typeface for Children with Low Vision

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Abstract: Children with low vision are at a disadvantage in reading compared to their peers because of the poor quality of visual input. This paper will examine the various definitions of typeface legibility, and the reading problems of low-sighted children. It explores the typographic parameters that can be controlled in order to improve the legibility of typefaces. It will also present the experiment design that tested these parameters and the PhD research results. As part of this research, these findings were implemented in a new typeface design, Matilda, which is research driven in order to improve the decoding times of young readers.

Key words: Type Design, Typography, Legibility Research, Low Vision, Ergonomics.

1. Introduction

Reading is done without consciously recognizing letters (Warde 1956, Unger 2007). Nevertheless letters constitute an important aspect of determining legibility (Rayner & Pollatsek 1998). Letters need to be decoded in order to obtain meaning. Reading is a complex, cognitive and fast process. Children having serious problems with reading are at an increased risk to end up in a cycle of failure (Stanovich 1986, Wolf 2007). When reading is a slow and cumbersome process, it will have consequences for the cognitive behaviour and motivation. A person whose reading process is impeded is less able to develop both intellectually and socially. Because most of the process of learning to read is finished after the age of 9 it is important that children who encounter difficulties are supported in the initial stages of this process (Stanovich 1986, Marquet et al. 2006).
Due to the low quality level of visual input they receive in the form of printed text, beginning visually impaired readers are at a disadvantage in comparison to their peers. The reading process is disturbed due to a reduction in visual input (Gompel et al. 2003, Gompel 2005). Children with a visual impairment have problems with the decoding of words, the deciphering of visual patterns and the recognition of letters. Because their decoding is hampered, the reading speed is lower, which eventually can lead to cognitive problems. To improve the visual input, a lot of attention goes to optical reading aids or the use of large print. Large print is often seen as a quick fix to show that efforts have been made for the visually impaired. Research has shown that large print books are not so effective for the technical reading process for most of the children with low vision (Lovie-Kitchin et al. 2001, Corn et al 2002).

2. Typography and Legibility Research

In the past, typography has often been looked upon as a useful instrument to improve the legibility of the printed reading material that is being offered to children with low vision. However, the legibility research efforts that were at the base of this conception were not always of good quality. For the cognitive scientists this is all too often caused by inadequate domain knowledge of typography. For the designers, this is due to a merely intuitive way of approaching legibility research (Dyson 1999, Lund 1999, Bessemans 2012). Many legibility studies focusing on the influence of design, both within cognitive science and within the design world, lack internal and/or external validity. This internal and external validity should be a prerequisite. Internal and external validity means that the testing material allows for isolating the effect of different design parameters[1] on legibility (internal validity) and that the testing material allows for discussing the result with regard to printed matter used in daily life (external validity). Moreover, most legibility research focused on people with low vision in general, ignoring the fact that visually impaired children constitute a very particular group with specific issues. Both the fact that their reading process has just started, as well as the fact that their visual impairment is not caused by ageing, make it difficult or even impossible to simply transfer results.

3. The Term Legibility

Another problem within the existing legibility research is the confusion regarding the term legibility. Many different groups of people (e.g. typographers, linguists, educationalists, ergonomics, psychologists, etc.) use the term and give it a personal related meaning without explicitly explaining it. The explanation is of importance to make legibility studies comparable. Within my PhD dissertation legibility is the ease with which visual symbols are decoded. This definition arose from the description of reading. Reading means: transposing visual symbols and converting them into linguistic meanings. To concisely define the term legibility attention goes to the two global and successive steps that occur when reading. Decoding and the acquisition of meaning, or the sensoric and the cognitive aspect of reading. Decoding or the sensoric aspect in reading is the conversion of the purely visual representation of words (which are not yet related to the meaning of these words). The definition used in this study is clearly related to this first sensoric aspect of reading.

4. Design Methodology Applied

Comprehensive legibility research takes into account a clear definition and both scientific methods and typographic practice. A designer-researcher is able to combine these two and thus guarantee the internal and external validity of the test material. The methodology of the design research is systematically constructed. The design is the point of focus throughout the research. The methodology starts with the context which is shaped by theoretical research (consisting both of

[1] Design parameters are design characteristics within the same font that can be isolated and can be manipulated independently of each other. A design parameter can therefore be related to the internal and external validity.

scientific and typographic matter) and practical work from other designers (mainly typefaces). This context will lead to an initial design that ultimately results in testfonts. During the process of designing the test typefaces the focus was on parameter designs. Departing from two existing typefaces (serif [DTL Documenta] and sans-serif [Frutiger]) a number of derived typefaces (five different parameters) was designed: variable x-height[2], conventional contrast[3], unconventional contrast[4], direction[5] and rhythm[6]. The five parameters were used to examine the balance homogeneous-heterogeneous in both form[7] and rhythm[8]. Using the concepts of homogeneity and heterogeneity we can say that in general sans serif typefaces are homogeneous within their letter forms and heterogeneous within their rhythm. With serif typefaces it is the other way around (certainly for serif typefaces based on the 20th century model): they are heterogeneous within their letter forms and homogeneous within their rhythm. Theoretical and practical insights concerning legibility in low vision children pointed in the direction of more heterogeneity. Notice that we never tested very extreme forms of heterogeneity.

5. Quantitative and Qualitative Legibility Research

The typefaces were tested by means of experimental (quantitative evaluation) and subjective (qualitative evaluation) legibility research. Both children with good eyesight and low eyesight were selected in order to study the reading skills and reading experiences in visually impaired children[9]. For the experimental part a psychophysical method was applied, presenting the children with pseudowords in the test typefaces for a short time on a computer screen, registering the number of errors (Figure 1). Taking into account the legibility definition used in this study, it were mainly the decoding skills of the children with low vision that were needed for the execution of this task. Moreover, pseudowords were used because these specific nonexistent words are the perfect carriers of the basic fonts and their derived fonts since phonological rules and convention within letterforms remain, while semantic knowledge and the influence of the context are excluded. In the subjective part of the project reading experiences of children who were confronted with the test typefaces were examined. The children were asked to rank the test material, 12 fonts, by the legibility of the

[2] By changing the x-height and the ascender and descender height of the letters, this design parameter induced a lot of heterogeneity, both rhythmically and in terms of letter form.

[3] This parameter adds contrast to the letter in a conventional way. Certain letter parts were emphasized in a conventional manner. This parameter mainly induced heterogeneity in terms of letter forms.

[4] This design parameter emphasized the most distinctive character parts within the letters. This induced in particular the heterogeneity of letter forms (because of less symmetry).

[5] Within this parameter, more heterogeneity was induced within rhythm by playing with the directions of the letter strokes.

[6] Within this parameter, more heterogeneity was induced within rhythm and letter form by varying the letter widths.

[7] The heterogeneity with regard to the letter shape can be illustrated by making related letters less similar.

[8] The heterogeneity with regard to the rhythm of the font can be illustrated by less successive letter strokes.

[9] 110 visually impaired children with no additional disorders participated in the study. They were recruited thanks to the cooperation of centers for the visually impaired in Belgium and the Netherlands. Also 54 normally sighted children participated in the study and were recruited by regular schools. All the beginning readers were in the age group of 5-10 years.

fonts (Figure 2). In het meanwhile it was examined which factors played a role in their subjective judgement by means of dialogue. Through the subjective legibility research, I was intensely involved with my target group before I started with the development of a final design. The feedback and the interaction with the children were of great importance for the design of the final typeface. The type designer very rarely gets immediate feedback from his readers. Type designers have always been very far behind the frontline when it comes to contact with the readers. The graphic designers, typographers, editors and publishers stand as a filter between the type designer and his readers.

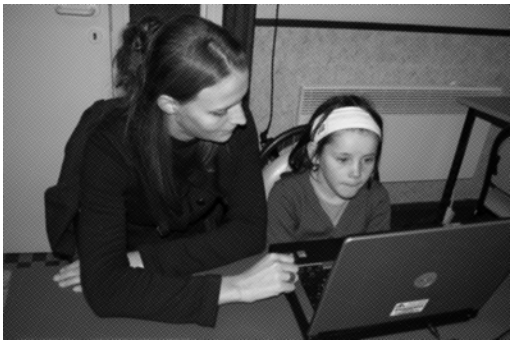

Figure 1. Experimental legibility research

Figure 2. Subjective legibility research

6. Results

The legibility research results showed a rather early conditioning with daily reading material in beginning readers. Children associated sans serifs with school and considered them to be writable; serifs they associated with literature (e.g. books and newspapers) and they considered them to be difficult to reproduce themselves. The non-visually impaired children generally perceived the most conventional typeface as being the most easily legible one. Amongst the visually impaired children this was not always the case.

Some of the children experienced social pressure to choose a normal letter. A remarkable finding is that children with normal vision read significantly better when the serif typeface DTL Documenta was used, instead of the sans serif Frutiger. This result is somewhat surprising because children

(especially beginning readers) are mainly confronted in primary school with a sans serif. Zuzano Licko's (1990) known quote: '…the readers read the best what they read most' is thus jeopardized, certainly for beginning readers in the age group of 5-10 years. The teachers' belief that letters for beginning readers should look as simple as possible and should reflect handwriting is falsified by this study. In visually impaired children the difference between both typefaces is less pronounced. During the reading (decoding) process non-visually impaired children appear not to be hampered by a homogeneous rhythm, but rather by a homogeneous form. The children with low vision however, seemed to be hampered more and even in particular by a homogeneous rhythm. Within the DTL Documenta font set (the basic font with a homogeneous rhythm) the design parameters – rhythm[10] and direction – that made the rhythm the most heterogeneous, had the most positive effect on legibility (in terms of decoding). It appears that for visually impaired children a more irregular rhythm is beneficial for their reading. Also it may be so that a certain degree of formal heterogeneity offers support (as we saw with the normally sighted children).

7. Matilda

Starting from these findings, together with my own understanding, knowledge, intuition and ideas as an design researcher, a typeface called Matilda[11] was designed that is able to provide support for the target group of visually impaired children in the first stages of the reading process. The new typeface is similar to the basic fonts DTL Documenta and Frutiger in terms of letter width and text colour. Matilda is based on a serif typeface, in order to reduce the gap between the reading material for non-visually impaired children and those with low vision. Furthermore design parameters within the DTL Documenta font set had the most positive effect on the decoding skills for children with low vision.
Matilda is in full development and a growing type family (also ready to test within new legibility research) (see Figure 3). The typeface includes a serif (see Figure 4), an italic, a bold, a sans serif. Matilda is also extended by the design parameters that were most helpful to improve the decoding process of children with low vision. These are mainly the parameters rhythm (see Figure 5) and direction (see Figure 6)[12]. More research will be done because it would be interesting to know in which a lesser degree is still helpful. Also the outcome of interaction effects would give more insight in legible fonts for children with low vision (and human perception). The main characteristics of Matilda are wide, open and round letters which have a friendly feeling (see Figure 6). The letters are dynamic and solid, constructed and organic. The letters are built on a rather stable and vertical axis. The curves are open, the serifs are asymmetric, convex and concave. There are ball terminals to emphasize the letter terminations to augment its individuality and

[10] It became clear that the difference with respect to the design parameter rhythm and their basic font is not seen by most of the beginning readers. This parameter can therefore be useful for practical use because it induces legibility while remaining invisible.

[11] Named after the book 'Matilda' from Roald Dahl (1988).

[12] Emphasizing letter parts seems to be helpful for visually impaired children in the lowest reading level.

distinctiveness. The low contrast in the letters is necessary to easily enlarge or reduce text. If children with low vision are reading in different contrasts/colours (they often do by computers) the letters need to remain very clear. Matilda doesn't have a very large x-height. The ascenders and descenders provide enough room for diacritics.

Figure 4. Matilda Regular, Bold & Italic

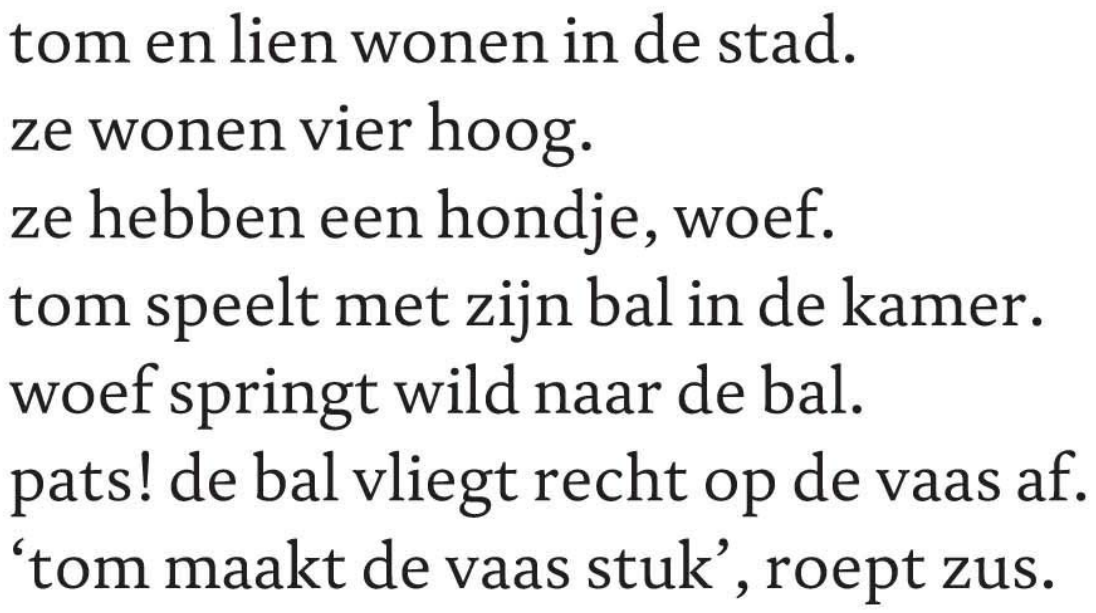

Figure 4. Matilda Regular

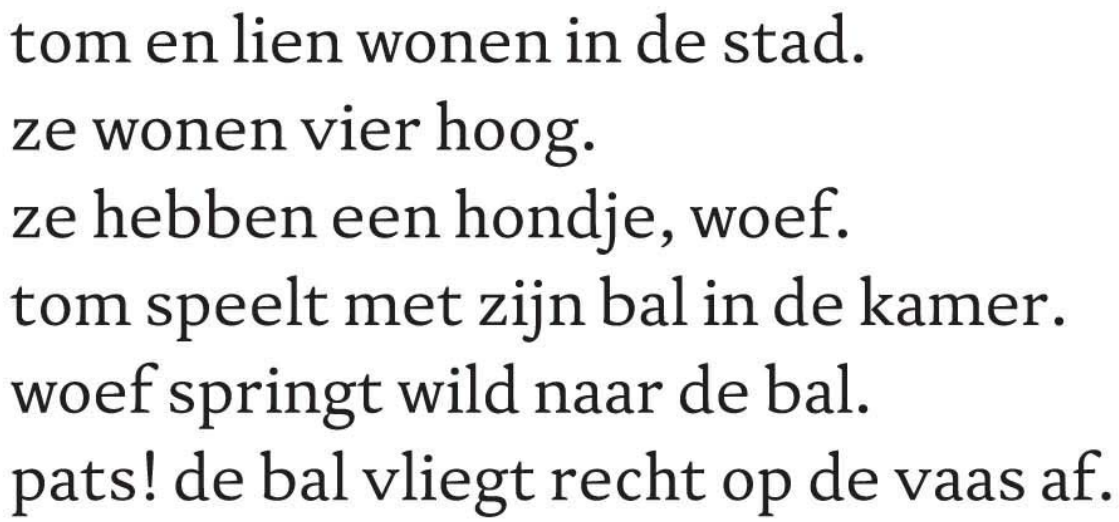

Figure 5. Matilda Rhythm

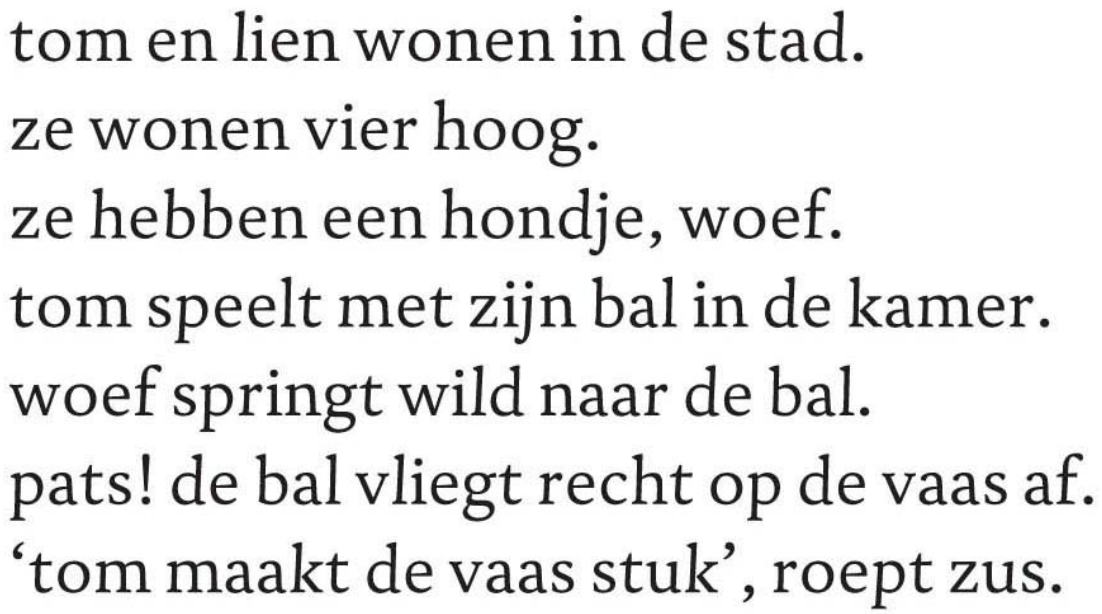

Figure 6. Matilda Direction

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