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**How Does Text Design Affect Reading
Comprehension of Learning Materials?**

Hur påverkar textdesign läsförståelse av inlärningsmaterial?

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Abstract

All humans are different and therefore they all learn in different ways. This research paper investigates what effect learning materials has on reading comprehension. The focus is not on the content of learning materials, but on the text design of materials and what effect they have on learners. This research paper focuses on aspects such as text design, typefaces and text spacing and how that affects reading comprehension. The primary search method used is electronic which was done on the websites Libsearch, ERIC and SwePub. The results show that choosing typefaces and text spacing mindfully, has a positive effect on reading comprehension.

Equal contribution to the paper

We hereby state that we have taken equal part in the process to writing this paper. The different parts being:

- Deciding the research question/s.
- Planning the writing and searching process.
- Searching for reliable and relevant articles and other literature.
- Deciding on the design and structure of the paper.
- The last decisions regarding the results and conclusion.

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Introduction

When selecting learning material for foreign language lessons, most research has its focus on the content and information output of the material. From experience at our VFU and teaching, we felt that material accessible for learning English as a second language in Sweden is rather monotonous with one looking a lot like the other. Sheldon (1988) describes many different aspects of how to critically look at and evaluate learning material, we have chosen to focus on one of them in our research paper; the layout/graphics of the learning material. To be able to achieve comprehensible learning material, focus must lie on many different combinations of text formatting and its variables. The difficulty is to determine which combinations of variables that are responsible for the effects on comprehensibility (Grabinger & Amedeo, 1988).

During our time in different classrooms and with different teachers, we were getting increasingly aware of the massive amount of learning materials available for the classroom. When we asked teachers why they chose a certain material, apart from content, the answers were often unfounded and haphazard with motivation like; it looked nice, pretty pictures and it was easy to read. This got us contemplating on how learning material was chosen and created. Our experience was that when teachers choose and create tasks, instructions and over all material, content is the most important aspect. Yet we believe that the design of the text also influences the readability of the learning material. During our time as teachers, we have heard things in passing, such as Arial should be used because is it more readable, but without any explanation or background. We have also heard that the content is the most important part of the material, but don't agree. Therefore, we wonder if there is a better way for us to distinguish good learning materials without focusing on the content.

According to McKenny, Kali, Markauskaite and Voogt (2015) teaching is increasingly considered as a design science, where the teachers are required to create appropriate learning material for the learners (p. 181). Despite this, the education of future teachers today, spend little time on the learning material itself, in addition to lesson planning. When selecting and creating learning material we therefore think teachers should not only consider the content of the material, but also reflect on the formatting and layout. As Li (2014) express, one should *“pay less attention to the apparent beauty of the courseware, but more to the inner logic that serves the purpose of teaching”* (p.26). It is easy to be swayed by colors and beautiful pictures, but one needs to be aware of how to choose learning materials comprehensible in all aspects.

Selander (2007) claims that learners have to, without any complications, be able to obtain needed information from instructions and other learning material to be able to carry out the task at hand (p. 165). Meeting this criterion can be completely different for each learner. One must understand that no one can learn everything, no matter how much they want to. We think, just as Selander (2007), that every student is a different kind of learner and has different strategies that work for them which is supported by what Skolverket (2011) specifies; education can never be the same for everyone, and teachers are the ones that must take into account each learner's needs. Teachers therefore should have in mind how the text design is presented to maximize the students learning. In addition, the Swedish school law (SFS, 2010:800) states that Swedish schools have a large responsibility for learners that, who for different reasons, experience difficulties in achieving the goals for the education. We have from experience found out that some difficulties lie within learners' comprehension of the material.

Research questions

Purpose

The purpose of this research paper is to find out if the design of the text in learning materials affect reading comprehension. This paper explores if there are any differences in reading comprehension depending on how the learning material is formatted. We do this because we want to learn how to choose and create learning materials that are beneficial in promoting reading comprehension.

Questions

1. How does the text design affect reading comprehension of learning material?

Sub-questions

1. How does typefaces affect the reading ability of foreign language learners?
2. How does text spacing affect the reading ability of foreign language learners?

Background

In this section, there is a description of key terms that are used throughout the entire research paper. In addition, some theoretical concepts that are crucial for the question and results are presented. Lastly, connections to the *Curriculum for the compulsory school, preschool class and the leisure time centre 2011* (Skolverket, 2011) are made.

Key Terms

Text design

Text design is how the material is presented, and how the reader comprehends the material. This text investigates if there is a preferred way to design the material so that it aids reading comprehension. When researching text design of learning material, information and studies about typeface and text spacing was found. Though typefaces and text spacing are not the only aspects, these were the ones that we chose to focus on.

Typefaces

Typeface is the term for the formatting of a text, including font, font size, weight (bold), italics, etc. Font type is the style of the letters written. Two font types that often are used is Times New Roman, which is used in this text, and Arial. There are two general groups of fonts, serif and sans serif. Serif fonts have small finishing strokes at the end of the stem of a letter, for example, Times New Roman is a serif typeface, and Arial is sans serif, without serifs (see table 1).

Font	Font Size 12	Font size 14	Sans serif or Serif
Times New Roman	Kajsa & Rebecca	Kajsa & Rebecca	Serif
Cambria	Kajsa & Rebecca	Kajsa & Rebecca	Serif
Calibri	Kajsa & Rebecca	Kajsa & Rebecca	Sans Serif
Arial	Kajsa & Rebecca	Kajsa & Rebecca	Sans Serif

Table 1. Examples of different fonts, font sizes and if the font is sans serif or serif.

Fontsize is the size chosen for a particular font and is defined by points, e.g. 12pt. As font size is based on the size of the letter blocks used in traditional typesetting the x-height, the



Figure 1. x-height comparison between Times New Roman and Verdana

actual height of the central body of the letter (see figure 1), varies amongst different fonts with the same font size (Bernard, Chaparro, Mills & Halcomb, 2010, p. 88). As shown in figure 1, the x-height of Times New Roman and Verdana differs greatly despite both being formatted to 26pt.

Text spacing

Slattery & Rayner (2013) describes the different terms intraword spacing and interword spacing. Intraword spacing is the space between the letters within a word and interword spacing, more commonly known as spacing, is the spacing between the words in sentences and texts (p. 1275). There is also interline spacing which Zorzi, Barbiero, Facchetti, Lonciari, Carrozzi, Montico, Bravar, George, Pech-Georgel & Ziegler (2012) describes as the spacing between the lines in a text (p. 11456). For clarification of different text spacings, see table 2.

Spacing	Sentences	
Intraword spacing	Standard	Intraword spacing
	1 space between each letter.	I n t r a w o r d s p a c i n g
Interword spacing	Standard	Interword spacing has more space between the words.
	4 spaces instead of 1 between each word.	Interword spacing has more space between the words.
Interline spacing	Standard	When you read you might feel more comfortable with having more space between the lines, this way you might not be confused on which line you are on when reading.
	Space 1,5	When you read you might feel more comfortable with having more space between the lines, this way you might not be confused on which line you are on when reading.

Table 2. Examples of intraword, interword and interline spacing

Reading ability

In this research paper the focus is on three different aspects of reading ability. The three reading abilities are reading accuracy, reading rate and reading comprehension. When describing these aspects, the word *you* is used as an example target for understanding. Reading accuracy is how many mistakes occur when reading (Hakvoort, Van de Boer, Leenaars, Bos & Tijms, 2017, p. 106). For example, when you read a sentence, which is adapted to your reading level, the reading accuracy is higher. Correspondingly, when you read sentences that are more advanced in level than yours, more mistakes are made resulting in a lower reading accuracy. Reading rate, also called reading speed, is in which rate you read a sentence or a text (Hakvoort et al., 2017, p. 107). For example, if you have read a text 5 times, you will probably read the text faster the 6th time. But if you have not read the text before, you might get hung up on certain words or chunks which will slow down your reading rate. Reading comprehension is used when explaining how much you understood after reading a text (Hakvoort et al., 2017, p. 110). Testing comprehension could be done, for example, by asking different questions about the content.

Theoretical concepts

Text-design theory

Prior research on text-design summarize that the road to reading comprehension always starts with taking in the text design and its information. By improving a text's legibility, it can aid reading comprehension. In *Text Legibility and the Letter Superiority Effect* (Sheedy, Subbaram, Zimmerman & Hayes, 2005) the influence different typefaces have on the legibility of a text is explored. As stated by Sheedy et al. (2005) the intention of font design is to improve text legibility and by looking closer at text parameters such as font size, font type, and font formatting; e.g. italics and bold; the text legibility was evaluated (p. 812).

By assessing reading rate or reading comprehension as a measure of text quality, Sheedy et al. (2005) came to certain conclusions. Firstly, a font size larger than Verdana 10pt (x-height 9 pixels) does not improve legibility of words nor letters. Secondly, despite earlier theories that serif fonts are designed to define and discriminate individual letters from one another to support young readers in the process of letter and word legibility, Sheedy et al. (2005) found that the most legible texts were written in sans serif fonts. Though this finding does not give us a

conclusive indication that sans serif is preferable since the two least legible fonts was one serif (Times New Roman) as well as one sans serif (Franklin). Sheedy et al. (2005), therefore reports that the legibility of a font should be determined separately. Thirdly, the research shows that a font enhanced with bold is more legible than a default text. It also finds that font enhanced with italics makes the text less legible.

Slattery and Rayner (2013) also investigates reading rate and reading comprehension, but instead of different fonts, they analyze different types of text spacing. The result in their first experiment, was that the sentences written in the font Cambria was read faster than the sentences written in Times New Roman, whereas the significant finding was that the font type did not matter as long as the standard spacing was used. In their second experiment they instead used the fonts Consolas and Georgia. The results were that it took a small amount of time longer to read the sentences written in Consolas. Therefore, Slattery and Rayner (2013) reports that increasing or decreasing intraword spacing and interword spacing is not beneficial in comparison to using the different fonts with their preprogrammed default spacing. Both Slattery and Rayner (2013) and Sheedy et al. (2005) performed their research on English speaking learners in American universities. Despite this, we hypothesize that the theories of typeface and text design reached here should be applicable on all texts, including learning material for learners in the ages 6-15.

Dyslexia

Some of the studies examined in this research paper perform their studies on children with dyslexia. Zorzi et al. (2012) describes developmental dyslexia, often mentioned as dyslexia: *“Developmental dyslexia is a severely invalidating learning disability that affects literacy acquisition in about 5% of the school population despite normal intelligence and adequate instruction.”* (p. 11455). Even though dyslexia are not the focus of the questions the results might benefit its cause. Just as teachers use a daily schedule with picture support for our special needs learner’s sake, it is also known that the method benefits all learners. Therefore, the positive and negative research results should be applicable to other students as well, not just learners with dyslexia.

The Curriculum in Swedish Schools

The curriculum and especially the syllabus in English do not state that teachers should consider what typefaces and text spacing to use when creating learning material. Then again, learning

should be accessible for all students, this including learning materials. The syllabus in English, core content for grades 1-3, Skolverket (2011) states that they should learn how to listen and read "*simple instructions and descriptions*" (p.33). Which means that the instructions and descriptions needs to be comprehensible, but it does not clarify how teachers are supposed to choose and create learning material. There are no guidelines for teachers to use; therefore, it is up to each individual teacher to choose and/or create material as comprehensible as possible.

Method

This section gives a detailed description of how the information needed for this research paper was found. The different databases and the search terms used are all listed below, and in addition to that, the inclusion criteria and exclusion criteria are presented. At last, each study chosen to help the analysis is presented.

Methods description

The primary search method has been electronic, using databases such as Libsearch (Malmö University's Library Database) ERIC (Education Resources Information Center) and SwePub (National Library of Sweden) to find research papers and books.

Firstly, we used Libsearch to gain an overview of the research that could be found within this area. The search focus is on the design and formatting of learning material, not the content. It was shown that this area has taken little ground in the educational research. It was also hard to find a common denominator and therefore reliable information.

Secondly, we searched for information on the more restricted databases ERIC and SwePub. This gave us limited number of results even when using different search terms. Because of the limited results in ERIC and SwePub we then returned the focus back to Libsearch. Which was the database for finding most information needed to answer the questions. In addition to the electronic search, the reference lists of the articles already found, were used to gather more literature to expand our material base.

Search terms

Below, the different words/terms that were used when searching for articles are presented. The words/terms were used both separately and in different combinations. The words are chosen wisely in the sense of what the paper is about. Also, some words originate in articles already found and then used to get further relevant results.

- Education
- Effect
- Affect
- Learning
- Lesson
- Structure

- Design
- Text
- Formatting
- Typefaces
- “Intraword spacing”
- “Interword spacing”
- “Interline spacing”
- “Font size”
- “Font type”
- “Text spacing”
- “Structural design”
- “Instructional design”
- “Didaktisk design”
- “Visual learning”
- “Reading comprehension”

Inclusion Criteria

The article was included if the following two criteria was fulfilled:

- It is about the structure and text design of learning material and the affect it has on the students’ learning outcomes.
- It is peer-reviewed. (This also limited the search results).

The age criteria is set to 6-15 -year-olds, but it was sometimes overlooked if an article had information that was crucial to the questions. The date range was from 1980 and forward, however, other relevant articles were found when looking at reference lists of the articles already selected.

Exclusion Criteria

The article was excluded if one or more of the following criteria was fulfilled:

- It is about the content of the learning material.
- It is about the classroom environment.
- It is about the teacher’s work in the classroom.

Some exclusion criteria were overlooked if the article in question met up to one or many inclusion criteria in a clear way. For example, if the article is about the content of the learning material but also the design of the material, it is included.

Included studies

This research paper works with nine studies, five of them investigate the effect that typefaces have and four of them investigate the effect that text spacing have.

Typefaces

Simard (2008) collected data from 188 participants between the ages of 11-12 in Quebec, who was French native speakers. All data was collected in the students' regular classroom during English lessons and with the students' regular teacher. There were seven experimental groups and one control group, and data were collected through two tasks, a text and a reading exercise. The tasks were set to explore if the use of different enhancements, for example, italics, bold and underlining, made a difference of the comprehension of a text. Simard (2008) concluded that the use of bold and underlining made some influence on the comprehension, but the other enhancements did not.

Sheedy et al. (2005) conducted a study with the total of 30 participants in the ages between 18 and 35. The participants were students from Ohio State University that had to have normal vision, either with or without glasses or contact lenses. The participants were tested in four different experiments where the legibility of words and letters were tested (fonts, font size, pixel height and font smoothing). The findings and the conclusion was that the fonts Verdana and Arial was the most legible, but in the other areas (font size, pixel height and font smoothing) Sheedy et al. (2005) could not find that that the legibility of text differed.

Bernard, Chaparro, Mills and Halcomb (2010) investigated the actual readability and the perceived readability of text in different fonts and font sizes. It was tested on 27 participants who were between the ages 9 and 11 and all the participants had 20/20 vision which is defined as normal vision. The tasks were eight different texts which had one of the combinations, either font size –12 or –14 in one of the following four fonts, Times New Roman, Courier New, Arial or Comic Sans MS. The tasks were done individually in a quiet room. Bernard et al. (2010) concluded that font size 14 was more readable than size 12. They also conclude that the fonts Arial and Comic Sans MS was more readable than Times New Roman and Courier New.

Wilkins, Cleave, Grayson and Wilson (2009) looked at the possibility that fonts, font sizes and different spacing impaired reading comprehension. They did this by conducting 4 different studies. Number two and four not relevant for this study. Their study number one investigated reading comprehension and reading rate. The first study were divided into part A and part B. Part A having a larger font size (26pt) and part B having a smaller font size (22pt). Both tests were individually done by the participants, and between the two parts there was a break. Wilkins et al. (2009) found that the larger font size were comprehended at a larger scale and it was read faster. The third study investigated font design on a total of 80 participants between the ages of 8-9. The study was divided into two parts with two different fonts. Part one was in font Sassoon and part two in font Verdana. The participants were to read the words aloud without prompting or making errors and this was timed. Wilkins et al. (2009) could see no significant difference, though some of the children preferred Verdana.

Katzir, Hershko and Halamish (2013) did two experiments. Both of the experiments were done on children from Israel, the first experiment on 45 second graders and the second experiment on 45 fifth graders. All the participants were given four different age-appropriate texts. The differences were, standard, decrease of font size, increase of line length and decrease of line spacing. The participants read the four texts individually at their school in a quiet room. Katzir, Hershko and Halamish (2013) found that the second graders had better comprehension with standard font size and the standard line length. The line spacing showed no significant effect on comprehension. When looking closer at the fifth graders, in comparison to the second graders, Katzir, Hershko and Halamish (2013) found the fifth graders had better comprehension with the decreased font size. Otherwise the results were alike. Katzir, Hershko and Halamish (2013) conclude that when someone manipulate text features, there will be an effect on reading comprehension.

Text spacing

Reynolds and Walker (2004) investigated if interword and intraword spacing had any effect on reading. When they conducted this study Reynolds and Walker (2004) got 24 six-year-olds to participate. The tests were formed to be as normal of a reading experience for a six-year-old as possible. The tests were divided into 2 and those two tests into four sections. One testing interword spacing and the other testing intraword spacing. The sections had smaller spacing than standard, standard spacing, little more spacing and the last section was with much more spacing than standard. The tests were done individually and the children were to read aloud.

Reynolds and Walker (2004) found that interword spacing had no practical significance, but when looking at intraword spacing, the standard was preferred.

Van den Boer and Hakvoort (2014) conducted an experimental study on intraword spacing with 105 seven-year-olds and 92 nine-year-olds with Dutch as their native or second language. Each child was submitted to read a total of 144 words divided into six lists of 24 words. Each one of the lists was to be read during 1 minute, to be able to measure reading rate and reading accuracy. The lists were randomized with monosyllabic and bisyllabic words, and also the intraword spacing differed between 6 different spacing alternatives (-0,5 to +2 with a 0,5 gap). Van den Boer and Hakvoort (2014) handed out the lists so that every child read both monosyllabic and bisyllabic words and all the different intraword spacings. They (Van den Boer and Hakvoort, 2014) concluded that there was no significant effect in reading rate or reading accuracy with the standard intraword spacing to the increased intraword spacing. But the -0,5 intraword spacing made the reading rate slower.

Hakvoort et al. (2017) did a study on reading accuracy when reading 44 sentences with standard spacing and then a week later the same 44 sentences with increased intraword and interword spacing. The participants were 30 nine-year-olds with dyslexia and with Dutch as their native language. A control group of 30 nine-year-olds without dyslexia were also submitted to reading the 44 sentences with standard spacing and increased spacing. Hakvoort et al. (2017) found that reading accuracy and reading rate increased slightly compared to the standard spacing. Though looking at an individual level there were some with dyslexia that improved significantly in both accuracy and rate with increased spacing.

Zorzi et al. (2012) initially collected data from 34 Italian and 40 French dyslexic children, between 8-11 years old, selected by meeting criteria of minimum IQ and a set level of reading accuracy and speed. As a control group 30 Italian children seen as normal readers at with the same reading accuracy and reading rate as the dyslexic children. In this initial test the children were asked to twice, separated by two weeks, read 24 sentences printed in black in on A4 paper with a typeface in accordance to the recommendations of the British Dyslexia Associations guidelines (Times-Roman font sized 14 pt). In the first session group 1 was presented with a text without extra spacing and the text group 2 was presented had increased intraword, interword and interline spacing. To follow this experiment another 20 Italian dyslexic children were selected using the same criteria as in the first test. Two texts were used that were equal in the amount of word and syllables as well as in word frequency and grammar. Both texts had

double interline spacing, but only one had intraword and interword spacing. As in the previous test the children were tested on two occasions, one on each text. The analyzed results showed that the increased spacing made the reading performance of the dyslexic children better on both occasions. On the contrary the spacing had no significant effect on the control group.

Result and Discussion

This section explores the question:

1. How does the text design affect reading comprehension of learning material?

Sub-questions

1. How does typefaces affect the reading ability of foreign language learners?
2. How does text spacing affect the reading ability of foreign language learners?

The findings have been divided into two categories according to the research questions. The first category is typefaces, which studies the effect of the design and form of the letters and words themselves. This category specifically focuses on text formatting, font size and font type. The second category is text spacing. This category investigates the effect the space between letters and words has on the perception of the text. The area is divided into intraword spacing, interword spacing and interline spacing. At last the findings are discussed in comparison to the theoretical concepts that were mentioned in the background section.

Results

Typefaces

There are several studies done regarding the effect the typeface in learning material. These focus on three different aspects of the typeface. Firstly, how variations of text formatting; such as italics, underlining, capital letters and highlighting; can enhance aspects of a text to promote comprehension. Secondly, how increased or decreased font size affect reading comprehension and reading perception. Lastly, how different fonts; such as Times New Roman and Arial; affect comprehension, reading rate and perceived readability.

Text formatting

Simard (2008) conducted a study on how different typeface cues affect the understanding of irregular plural endings; e.g. knife → knives. The study was conducted on two different occasions amongst 11-12 -year-old learner's studying English as a second language in Canada. A test material was created where irregular plural markers were enhanced in 8 different ways;

1. Italics
2. Underlining
3. Bold (Weight)
4. Yellow highlighter
5. Capital letters
6. All above (5-cue group)
7. Bold, capital, underlined (3-cue group)
8. Not enhanced (control group)

The study concluded that, in relation to other cues, italics was the least effective way to garner the reader's attention. On both test occasions text with italics lead to a poorer result in accurate answers and was twice outperformed by the unenhanced control group. The most efficient enhancements were using the capital letters, the bold and the 3-cue groups. These three enhancements outperformed the control group in both tests conducted. The positive result of adding extra weight to the text with bold cues correlates to Sheedy et al. (2005) results that an increased stroke width, a bold format, improved the readability of the text, but with certain reservations. Sheedy et al, (2005) argues that this only applies to the thinnest widths available, meaning that a too bold text might as well hinder readability.

Out of the three above, the most efficient cue was enhancing the plural endings with all capital letters (Simard, 2008). If this due to the letterform or the fact that the letters solely become larger in size is unclear, but it is of interest to consider when taking into account since it has also been found that the font size is more important than if the words are written in upper- or lowercase letters (Sheedy et al., 2005). The same research also found that lowercase words need to have an 10-20% increased size to maintain the same readability as individual lowercase letters.

Font size

The effect on font size is further researched by Bernard et al. (2010) studying the effect of different typefaces presented on computer displays among 9-11 -year-old readers. Using two variables, font (Arial, Courier, Times and Comic) and font size (12pt and 14pt), they tested the

actual effect on accuracy and reading speed, as well as how the participants perceived the different combinations. This research found that there were no actual differences in the results depending on the different font sizes. Despite this the participants found the texts in 14pt easier to read than the 12pt text and the researchers suggest that it supports the quality of reading.

Wilkins, Cleave, Grayson and Wilson (2009) also conducted an extensive study amongst 7-9 - year-old learners evaluating both font size and font type. This study corroborates the general finding of Bernard et al. (2010) that a larger font size of 26pt promotes a higher reading rate and accuracy than a size of 22pt. This somewhat contradicts the theory of Sheedy et al. (2005) who suggested that sizes above 10pt does not improve the legibility of the text. Nevertheless Wilkins et al. (2009) also shows that a decreased font size decreases the reading speed. This is in accordance to Katzir et al. (2013) research among second and fifth grade English language learners in Israel show similar results. The research found that reading comprehension and reading rate amongst the younger readers (second grade students) were impaired when the font size was decreased. Simultaneously the same research found that the decreasing font size also affected older readers (fifth grade students) by lessening their reading speed, but in contradiction to the younger readers this promoted the older readers comprehension of the text (Katzir et al., 2013).

Font type

Wilkins et al. (2009) also studied the difference in comprehension and reading rate between texts written in Sassoon and Verdana. Despite Sassoon being the font type most familiar to the participants and the one speculated to be favorable because it is easier to differentiate letters from each other, it showed a poorer result than Verdana. No significant difference in accuracy was found, but Verdana was perceived as more readable and Verdana increased the reading speed. When assessing the results from the different fonts used in their research Bernard et al. (2010) also found the font types used influenced comprehension and readability. Firstly, Courier was shown to have a lower accuracy rate than the other fonts tested. Secondly, Comic and Arial were perceived more readable than the other fonts. Overall, the two fonts with serifs (Courier and Times) were perceived as more difficult to read. This corresponds with the earlier findings of Sheedy et al. (2005) that shows that Verdana and Arial, both sans serif, are more legible fonts than Times New Roman, a serif font. Despite this Bernard et al. (2010) speculated that the poor results of Courier might not be due to the serifs but rather the wide letterspacing in the font, this after the researchers noted that the two most disliked fonts were the ones with

narrowest (Times) and widest (Courier) letterspacing amongst the four. Overall, it was found that the most preferred combinations for typeface were Arial 14pt and Comic 12pt (Bernard et al., 2010).

Text Spacing

All tests were done either reading a children's book (Reynolds & Walker, 2004) or reading words, chunks and/or smaller sentences (Van de Boer & Hakvoort, 2014; Hakvoort et al., 2017; Zorzi, et al., 2012). The tests had different kinds of spacing and the children were supposed to read at least two different ones with at least one week between the test so that children would not be affected by repetition, since the texts were the same, but not the spacing. The participants were all between the age six and fifteen. A minority of the participants had the diagnose dyslexia and some studies even took a look at adults, but those results will not be focused on, even though the results can be interesting in some aspects.

The results of the different kind of spacing will be divided into intraword spacing, interword spacing and interline spacing even though all the authors do not cover all three aspects.

Intraword spacing

Intraword spacing is the spacing between letters within words and Van de Boer & Hakvoort (2014) finds that the standards of intraword spacing is the preferred type of spacing. In their study the decreased and increased intraword space had a negative impact on the reading accuracy and reading rate. As the previous researchers, Reynolds & Walker (2004) could not confirm, that intraword spacing gave a positive effect on reading. They also concluded that the standard intraword spacing is preferred. Hakvoort et al. (2017) almost came to the same results, though they find that the reading accuracy actually can be positively developed with increased intraword spacing. The interesting part is that Hakvoort et al. (2017) tested both children with and without the diagnose dyslexia, but still, there were no difference in the results between children with dyslexia or not. Zorzi et al. (2012) on the other hand, found that both reading accuracy and reading rate is affected positively when using increased intraword spacing. The children made fewer mistakes when reading and they read faster than usual. Note that Zorzi et al. (2017) only tested children with dyslexia. But we think that does not have a crucial effect on the results, since Hakvoort et al. (2017) tested children with and without dyslexia and concluded that it affected them all positively.

Interword spacing

Interword spacing is, as explained before, the space between specific words and the researchers have different results when it comes to either using standard or increased interword spacing. As with intraword spacing, Hakvoort et al. (2017) finds that the increased interword spacing helps the reading accuracy, but not the reading speed, for both children with and without dyslexia. Zorzi et al. (2012) concluded that the increased interword spacing affects both the reading accuracy and reading rate positively. On the contrary Reynolds and Walker (2004) only saw very small differences in results in both reading accuracy and reading speed, so they felt that they could not draw a conclusion of their findings.

Interline spacing

Interline spacing is the spacing between the lines and both Hakvoort et al. (2017) and Zorzi et al. (2012) uses interline spacing in their test, but only Zorzi et al. (2012) describes their findings. The results Zorzi et al. (2012) came to, were that manipulating interline spacing was not necessary. At least not as necessary as intraword spacing and interword spacing. Using the default interline spacing was the most beneficial for the participants reading ability.

Discussion

So how does the text design affect the reading comprehension of learning material? The text design, which consists of many variables, does most certainly affect the reading ability at least in the two different aspects that were examined. Firstly, when choosing different typefaces, it affects the reading ability, either positively or negatively depending on how one chooses to present the text. Sheedy's et al. (2005) research concluded that Arial and Verdana as a sans serif font type, is more comprehensible. Sheldon's (1988) research on ways of evaluating learning material, despite being over 30 years old, also shows that it matters if they use a serif font type or a sans serif font type. This is because the learners will comprehend the information differently. Generally, a larger text in a sans serif font is more likely to better support reading ability. In addition to that learners can be further supported in their comprehension by using capital letters and bold cues to highlight important information.

Secondly, even a discrete aspect such as text spacing affects the learners reading ability. The exception was interline spacing that did not show an effect when decreasing or increasing. This is interesting since text spacing is what often is changed in text editing e.g. this text has an increased interline spacing of 1.5. As mentioned before, when introducing dyslexia in this paper, we argue that something that can help a special needs learner, can be beneficial for all learners. We can now support that claim by the results of Zorzi et al. (2012) and Hakvoort et al. (2017). They showed that intraword and interword spacing changes made for dyslexic children also gave a positive effect on reading accuracy among non-dyslectic readers.

The one aspect that we are unsure that is answered is how it affects foreign language learners. Since some of the researchers did experiments on native English learners, and some on English as a foreign language learners a specific result that set the English as a foreign language learners apart could not be discerned. In addition to that some studies were made in Italian, French and Dutch, but since the methods and results correlated, we conclude that the findings of this research paper should be applicable on foreign language learners.

The Swedish curriculum mentions the content that teachers are supposed to teach, and also what knowledge requirements that they will assess, but it does not specify how the material and instructions preferably should be presented to the learner. Despite this Skolverket (2017) implies the importance of typefaces and text design without supporting it with any prior research. Giving such information leaves the teachers as the determiners of how learning

material is presented to learners. That leaves a lot of options for creating and choosing learning material's design which might have a positive or negative effect on the learning material.

To be able to choose and create learning material that promotes comprehensibility, it is important to be educated in the matter. Unfortunately, the research is often hard to find. As Simard (2008) noted, typographical cues and typefaces are often used on the material creator's personal preferences. These choices should not be made so randomly as they effect the readability of the material. To encourage a change in this, we believe that more research should be conducted on text design with a specific focus on learning material for English as a second language. The research available today is too broad and focuses on too many different aspects of text design. Our hope is that a more homogenous research platform with more results could lead to reliable guidelines that could be referred to when creating learning materials.

Conclusion

Based on the results of this research paper we are confident in concluding that the design of learning material, in regard to typeface and text spacing, have an effect on reading comprehension.

Firstly, we ultimately found that manipulating the typeface of a text can, and most definitely will, affect reading comprehension, reading rate and text perception (Katzir et al. 2013, Simard 2008, Bernard et al., 2010). The conclusion is that the most optimal typeface for reading is a sans serif font with medium to large size and modest letterspacing and weight (Bernard et al. 2010, Sheedy et al. 2005, Katzir et al. 2013). Enhancements of text segments is preferably done by using capital letters and/or bold letters (Simard, 2008).

Secondly, we concluded that in all the four studies (Hakvoort et al. 2017, Zorzi et al. 2012, Reynolds and Walker 2004, Van de Boer & Hakvoort 2014) represented in the category of text spacing, we can see that both increased intraword and increased interword spacing gives the reading accuracy a boost. However, the research done on increased interline spacing shows that it is of no importance for either reading accuracy or reading rate except on an individual level (Hakvoort et al. 2017, Zorzi et al. 2012).

Limitations of this research paper is mainly in the limited amount of research in the area and the many different aspects it focuses on. There is no common terminology to use when finding the research and, in the end, found and used 9 original studies that correlated to the research question.

Finally, the text design has an effect on readers, but the research is limited. It would be interesting to look closer at other ways of evaluating learning material. What else matters? If doing a thorough analysis of all different aspects, could that result in one optimal way of presenting learning materials? We are adamant that further research is needed in this area, both in the aspect of getting a solid base of information and credibility as well as becoming a key area in learning material design.

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