Differences between Children's Handwritten Stories and Those Typed on a Computer

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Abstract. The goal of this study was to examine the usefulness of the computer as a story-writing tool for young children. Forty children produced a total of eight stories each over a period of one and a half year. Half of the stories were written, whereas the other half was typed on a computer. The stories were not only recorded on a computer but the temporal data gathered during the production of the stories were also recorded. For the written stories we used Oasis and for the typed stories Scriptlog. This presentation will mainly focus on the temporal data. A first analysis of the data indicates longer pause times in the typed stories compared to those in the written stories. In the following months we will analyze the acquired data in detail by examining both the pause times between specific types of words and the pause times between specific groups of words. The correlation between the pause time data in the stories and the performance on both writing- and typing tests also appears to be of interest.

1. Introduction

Most children learn to read and write quite easily during the first years of primary school, and for most of them this learning process is not unpleasant at all. However, there are also children for whom the acquisition of these new skills does not come so easily (Rosegrant, 1985). These children need extra guidance and assistance to master language skills to an adequate level. Unfortunately this extra help is often not available in a normal classroom situation due to the limited resources of the teachers. Therefore a device that could assist children while they are engaged in tasks like reading and writing could provide a solution to the problems mentioned.

Recent developments in the area of multimedia make it possible to develop a wide variety of educational software. The field of reading and writing and language education is well suited for computer-based learning. Successful use of computers for the training of these skills, however, requires that children can interact easily with the computer. After all, insufficient computer-skills affect the learning process negatively when the computer is used as an educational tool. A major problem when computers are used for training children's language skills, like word spelling, sentence-construction, and story-construction is a lack of typing skill in young children. Insufficient typing skills cause attention to be drawn from the task proper, which may negatively affect sentence construction and story composition performance. Research by Cunningham and Stanovich (1990) show that writing is superior to typing on a computer keyboard, when it involves the improvement of spelling skill. Typing, however, is not always detrimental. Typing is a solution for children who have great difficulties with their handwriting as a result of motor problems (Johnson & Carlisle, 1996).

The study described here examines the development during the first two years of primary education of children's literacy performance of computer-produced texts compared to the literacy performance of written texts. In this study not only the final texts are analyzed but also the pause times during the production of the texts. An attempt will be made to find an answer to the following research questions:
- What are the differences in the process of writing by hand versus writing with a computer?
- How can the individual variation in handwriting and computer writing ability at the start of grade 7 be explained?

By doing so we hope to gain better insight in the specific difficulties that children face when writing or typing texts. To get an insight in the writing and typing processes we will look at the pause times before the words in the stories. Except for the distinction between the written and typed stories we will also make a distinction between function words and content words. Function words are words of a 'closed class' such as pronouns, articles, conjunctions, quantifiers and prepositions. Content words however are words of an 'open class' such as nouns, verbs, adjectives, and adverbs. In their study in the field of naming times for function and content words Segalowitz and Lane (2000) found faster naming times for function words than for content words which they attributed to word predictability and word familiarity.

Based on this literature we expect the pause times before the function words to be generally shorter. A factor that is likely to be very important when writing stories, and therefore may explain some individual variation between the children's story writing qualities, is handwriting skill, or 'penmanship'. This skill will be reflected in the handwriting speed and legibility (Graham, Weintraub, & Beringer, 1998; Graham et. al., 1998; Karlsdottir, & Stefansson, 2002). When typing stories the children's keyboarding skill will obviously be of similar importance as writing skill when writing them.

2. Method

2.1 Participants
In this experiment participated 40 children of two different elementary schools. The experiment started in the middle of Grade 1 and the average age of the children was then around 84 months.

2.2 Materials
To collect the temporal aspects of the written texts an xyz-digitizer-tablet of the type Wacom 1218 was used. The tablet was connected to a laptop computer and was equipped with a special pen designed specifically for use on the tablet. The actual texts were written on an ordinary piece of paper without lines, size A-4, positioned on the digitizer. The Oasis software package (version 7.31) was used to control the data-collection by means of the digitizer-tablet (De Jong, Hulstijn, Kosterman & Smits-Engelsman, 1996). To collect the typed texts a laptop computer was used in combination with ScriptLog. ScriptLog is a program that records all spatial and temporal aspects of typed texts (Strömqvist, 2000). To practice typing, Microsoft Notepad was used. For the assessment of typing speed and for the collection of the typed stories the build in word processor of ScriptLog was used which is comparable to Microsoft Notepad. To make typing somewhat easier for the children a normal desktop keyboard was connected to the laptop.

2.3 Procedure
In a period of two years, each child wrote eight stories. During these two years there were four periods of about one month in which the stories where actually collected. At any one of these periods each child engaged in two writing/typing sessions. During one of these sessions the child was asked to write a short story, by hand, about a series of related pictures that depicted a story. In addition the child's handwriting fluency (consisting of both speed and legibility), reading accuracy and reading speed were measured by two tests (BHK and DMT respectively). The sequence of these tasks in each session was always the same: BHK, followed by DMT and finally writing the story. During the other session the child typed a short story by means of the computer and keyboard. Again a similar series of related pictures was used as stimulus. During this session, the child's typing speed and typing accuracy were measured. For this purpose the child had to copy a standard text, by using the computer keyboard. Before the children had to engage in one of the typing tasks they received a very short type training in which they were assisted in typing a short standard text. Moreover, during this session an indication of the child's working memory was obtained by means of the number reproduction task of the Kaufman-ABC. Again the sequence of the tasks was always the same: Kaufman's memory task, keyboard training, assessment of typing speed and accuracy, and finally typing the story.

2.4 Analysis
Of particular interest to this presentation are those variables pertaining to the pause times during the production of the stories. These data consist of the pause times before certain kinds of words or certain groups of words (e.g., content and function words). Other variables that were examined for each of the stories were, a) total number of words, b) number of sentences, c) sentence-length, d) the number of unique words per minute, as a substitute for the type-token-ratio as described by Renkema (1983), and e) spelling errors.

3. Results
The first preliminary results pertaining to the writing process, indicate a significant main effect of condition $F(1, 15) = 85.31$, $p < .001$. Overall, the pause times before the typed words were much longer than those for the written words. Furthermore a significant interaction between moment of measurement and condition was found $F(3,13) = 7.70$, $p < .01$. The pause times before typed words decreased, whereas those before the written words increased over time. Furthermore there was a significant interaction between word-type and condition $F(1,15) = 19.14$, $p < .01$. Content words were preceded by longer pause times than function words in the written stories, whereas the opposite was the case for the typed stories.
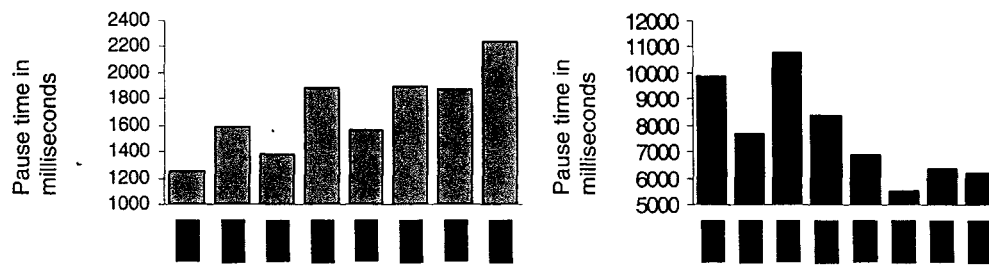
Figure1. Pause times before function words (FW) and content words (CW) in the written stories (left graph) and in the typed stories (right graph). The numbers after FW and CW indicate the moment of measurement.

To explain the individual variation among the children regarding story production skills, we looked at the correlation between the scores on the tests, the pause times before function and content words, and the number of unique words per minute. The scores on the reading test, working memory, handwriting legibility did not correlate significantly with any of the pause time variables or the number of unique words per minute. There was, however, a positive correlation between writing speed and the number of unique words typed and written per minute. The typing speed correlated positively with the number of unique words typed per minute but not with the unique words written per minute. A negative correlation was found between writing speed and the pause time for typed function and content words. The same was true for the correlation between typing speed and the pause time for typed function and content words. There was however a positive correlation between writing speed and the pause time before written function words. Reading speed correlated significantly with the number of unique words typed per minute. Table 1 gives an overview of the correlations discussed so far. Not shown in Table 1 is the correlation between writing speed and typing speed which was not significant.

Table 2 gives an overview of the correlations among the 'pause time variables' and the variables concerning the number of unique words in the written and typed stories. Remarkable is the positive correlation between the written words (both content and function) and the number of unique words typed per minute. The pause times in the typing condition, however, correlated negatively with the number of unique words produced per minute.

There is also a positive relation between the pause time before the typed function words and typed content words, whereas a negative correlation between the written function and content words emerged.

Table1.
Correlations between a scores on a number of test and the pause times within the stories and the number of unique words (*$p < .05$ **$p < .01$)

	Writing speed	Typing speed	Reading speed
Pause time before typed function words	-.65*	-57**	-.090
	($n = 12$)	($n = 20$)	($n = 20$)
Pause time before written function words	.69**	.16	-.10
	($n = 11$)	($n = 16$)	($n = 16$)
Pause time before typed content words	-.74**	-.58**	-.14
	($n = 12$)	($n = 20$)	($n = 20$)
Pause time before written content words	.41	.13	-.09
	($n = 11$)	($n = 16$)	($n = 16$)
Unique number of words typed per minute	.45*	.82**	.40*
	($n = 21$)	($n = 34$)	($n = 34$)
Number of unique words written per minute	.59*	.300	.30
	($n = 20$)	($n = 30$)	($n = 33$)

Table2.

Correlations between pause times within the stories and the number of unique words (*$p < .05$
**$p < .01$)

	Pause time before typed function words	Pause time before written function words	Pause time before typed content words	Pause time before written content words	Number of unique words typed per minute	Number of unique words written per minute
Pause time before typed function words						
Pause time before written function words	-.33 (n = 16)					
Pause time before typed content words	.85** (n = 20)	-.49 (n = 16)				
Pause time before written content words	-.15 (n = 16)	-.76** (n = 16)	-.40 (n = 16)			
Number of unique words typed per minute	-.72** (n = 20)	.40 (n = 16)	-.78** (n = 20)	.34 (n = 16)		
Number of unique words written per minute	-.26 (n = 16)	.55* (n = 15)	-.53* (n = 16)	.59* (n = 15)	.46** (n = 30)	

4. Discussion

The present results show some interesting patterns. In the writing condition the pause times before the function words were shorter than those preceding the content words, whereas the opposite was true for the typing condition. A possible explanation is that in the typing condition, children pause before function words, which are usually at the beginning of a larger piece of text, to make sure what they want to type. This way they can avoid retyping the text, which is a burden in case of inexperienced typists. With regard to writing, however, children perform an activity they are generally more familiar with at this age, due to a relatively greater amount of practice. Perhaps that in this more familiar condition the findings as reported by Segalowitz and Lane (2000) apply. The fact that the pause times in the typing condition decreased over the two-year period can probably be explained by a greater amount of typing practice over the years. The fact that the pause times in the written stories increased can perhaps be explained by an increased vocabulary and an increase in morphological and syntactical knowledge that cause the writer to be more critical towards its own writing product. This hypothesis will be tested by computing correlations between numbers of unique words and/or numbers of spelling errors on the one hand and the average pause time of the stories on the other hand.

From the positive correlation between writing speed and the number of unique words written per minute and the negative correlation between the writing speed and the pause times before the written words it can be concluded that writing speed can ease story writing. The same positive correlation was found between typing

speed and the number of unique words typed per minute, in this condition there was also a negative correlation between typing speed and the pause time before the typed words. Therefore it can be concluded that when typing stories children clearly benefit from a greater typing speed.

Remarkably, a positive correlation was found between the number of words written per minute and the pause time before the written words indicating that children pause longer before words when they write stories with more unique words, that are presumably also of a better quality (Renkema, 1983). This relationship was however not found in the typing condition were a negative correlation was found. Therefore it can be concluded that in the typing condition the number of unique words that are produced per minute and the pause time are both influenced by the child's typing difficulties. An additional interesting finding was that the pause times before the written function words correlate negatively with the pause times before the written content words. However in the typed stories a positive correlation between the two kinds of words was found.

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