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AUTHOR Hartley, James
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ABSTRACT

A study examined the ways in which children recall structured text. Subjects, eighty-eight 12- to 13-year-old children, studied a short passage for five minutes which was printed in either a "chunked" format (where phrases are segmented or presented on separate lines) or a "traditional" one. The children were then asked to write the passage out from memory. Results indicated that "chunking" did not significantly affect recall; however, the format of the presentation affected the format of the recall, with 44 out of 44 children in the chunked condition recalling in a chunked format, and virtually all of the 44 children in the traditional condition writing out their passages in the traditional way. (A table summarizing the results of 30 studies on structured text, a table of data, and 2 figures presenting materials used in informal and formal experiments are included; 42 references and a scoring sheet are attached.) (Author/RS)

Does What Goes In Determine What Comes Out? Recalling Structured Text

James Hartley

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James Hartley is Professor of Applied Psychology specialising in written communication at the Department of Psychology, Keele University, Staffordshire, ST5 5BG, UK.

Abstract

This paper reviews the results of over twenty-five studies on the effects of structured text on recall and comprehension, and presents the data from an additional study which also examines the ways in which children recall structured text.

In this experiment 88 12-13 year old children studied a short passage for five minutes which was printed in either a 'chunked' or a 'traditional' format. The children were then asked to write the passage out from memory. It was found that 'chunking' did not significantly affected recall. However, the format of the presentation affected the format of the recall, with 44 out of 44 children in the chunked condition recalling in a chunked format, and virtually all of the 44 children in the traditional condition writing out their passages in the traditional way.

Introduction

> *"It is intuitively clear that text is easier to read if it is formatted with linguistic structure in mind. Over the past two millenia, the development of phonemic alphabets has involved a consistent trend to reveal more of the surface phrase structure in the way text is printed: the introduction of spaces between words, special characters to begin and end sentences, the comma, and the addition of extra space after a period and comma, have all contributed to a representation of the prosodic segmentation which sentences would have when spoken. These developments are of both practical and theoretical significance. Practically, they suggest that reading performance can be improved by using a more complete reflection of linguistic structure in printing: theoretically, they suggest that certain kinds of prosodic information are important aids to normal sentence comprehension." (Bever et al, 1991)*

The quotation given above indicates the theoretical and practical importance of the experiment reported in this paper which had two main aims. Firstly, I wanted to see if spatially re-structuring a piece of text would affect the *amount* of information that a person might recall. Secondly, I wanted to see if spatially re-structuring a piece of text would affect *how*, or *the manner in which* that information might be recalled.

There is certainly a good deal of evidence available that shows that the spatial re-structuring of text can affect the *amount* of information recalled. Table 1 summarises the results of over twenty-five studies in this respect. These studies have employed a

wide range of materials and participants and, individually, they have reached a wide range of conclusions.

Table 1 is organised thematically in order to clarify these results. I start with studies of vertically printed text, that is the presentation of *one word per line*. For example:

In
1983
little
had
changed

(In electronic text this method is now called RSVP - rapid serial visual presentation - and this term describes both the presentation of single words and short phrases: e.g. see Cocklin et al., 1984; Huchingson et al., 1981; and Juola, 1988.)

I then move on to studies of '*square-span*' text. Here text is printed thus:

In 1983	had	in the	lives
little	changed	everyday	of the

Next come studies of text with phrases spaced *within* the lines and sometimes designated by a slash. Here, for example, text might be printed thus:

In 1983 / little had changed / in the
everyday lives / of the vast majority / of

Finally come studies of so-called 'chunked text'. Here phrases are segmented and presented on separate lines, sometimes with additional indentation to show sub-groupings. For example, the above material might be printed:

In 1983

little had changed

in the everyday lives

of the Tennessee people.

In 1984, however,

things began to stir.

In writing this review of the literature I have restricted myself to considering only those studies where the wording is held constant but the format of the text is varied. However, I have omitted references to studies making comparisons between 'justified' straight-edged text and 'unjustified' ragged right-hand edged text, for these procedures hardly affect the structure of the layout. (Readers interested in this debate may find the reviews by Hartley, 1987, and Hooper and Hannafin, 1986 useful). I have also excluded those studies where sentences within paragraphs are re-ordered, or paragraphs within sections are re-ordered, so that the text is presented in different conceptual sequences (see for example Greene, 1991; Schnotz, 1982; and Waller & Whalley, 1987). I feel that these studies, whilst interesting, are beyond the scope of this review.

Please insert Table 1 about here

It is hard to summarise neatly the results shown in Table 1 but it does seem as though:

1 Vertically printed text does not fare well (Tinker, 1955; Coleman and Hahn, 1966; Coleman and Kohn, 1961).

2 Most studies with children show that structured text helps comprehension at various levels of ability (Beggs and Howarth, 1985; Brozo et al, 1983; Gerrell and Mason, 1983; Negin, 1987; O'Shea and Sindelar, 1983; Stevens, 1981; Weiss, 1982). However, some investigators have only found benefits for low ability children (Kirby and Gordon, 1988; Mason and Kendall, 1979; Patberg and Yonas, 1978): indeed Patberg and Yonas found that the use of wide spacing to indicate phrase segmentation hindered able children. Others, however, have found the reverse (e.g. Taylor et al, 1985).

3 Most studies with adults (mainly university students) show either no significant effects on comprehension for structured text (Coleman and Kim, 1961; Cromer, 1970; Hartley, 1980; Hartley and Burnhill, 1971; Nahinsky, 1956) or positive effects (Anglin and Miller, 1968; Epstein, 1967; Frase and Schwartz, 1979; Green and Baker, 1987; Jandreau et al, 1986), although Keenan (1984) found negative effects on her speed measures. Some investigators have found structured text to benefit high ability adults and hinder less able ones (Klare et al, 1957; Stone, 1981) but Bever et al (1990) and Jandreau and Bever (1991) found positive effects with average and less-able adults.

In brief, if we exclude the studies on vertically printed text, the total picture looks quite positive. A bald summary of the results listed above suggests that there are 11 studies showing clear positive effects, 9 studies showing partially positive effects, 6 studies showing neutral effects, 2 studies showing partially negative effects, and only 1 study showing negative effects.

My own interest in this issue arose from my failure in both published and in recent informal, unpublished experiments to find positive results for spatially structured text. This has been particularly embarrassing since a key chapter in my textbook is devoted to, and advocates the virtues of, using space to show the structure of instructional text (Hartley, 1985)!

A common feature of my recent informal experiments has been to present small groups of university students in class with the materials shown in either Figure 1a or Figure 1b, and to ask them to recall it. (Figure 1b is based upon Bradbury Thompson's design for the Washburn College Bible: Thompson, 1988.) Typically there have been no significant differences in the amount recalled from either figure. In an earlier, unpublished study, I asked 61 university students to recall a recipe for making a bacon stew, presented either in the run-on prose style shown in Figure 1a, or in a structured format as in Figure 1b where space was used to separate out and group the sequence of instructions. Here again, the students recalled a similar amount of information from both versions. I concluded, in both cases, that perhaps university students were inappropriate participants in experiments of this kind: perhaps younger, or less-able readers might produce different effects.

Please insert Figures 1a and 1b about here

However, I did note one surprising fact. This was, with the university students, that what 'went in' determined what 'came out'. In one of my small studies on the biblical text, for

example, seven students had the continuous text, and six the structured text. All of the students who had the continuous text recalled it in continuous prose, and all of the students who had structured text recalled it in the structured manner. Similarly, in my study with the recipe, all but two students out of 30 with the continuous text recalled it in this manner, and all but one student out of 31 with the structured text recalled it in the structured way. In other words the format of the output matched the format of the input.

With this background information in mind, I decided to repeat my experiments with three major changes. Firstly I decided to use a simpler text than that shown in Figure 1. Secondly, I decided to use 10-11 year old schoolchildren instead of university students. Thirdly, I decided to vary the speeds under which the children would be asked to recall their texts. My reasoning here was that the respondents might be more inclined to structure the traditional text if they thought they had plenty of time to do so.

Method

Materials

A passage was created, based on the materials shown in Figure 1. Two versions of this passage were prepared which were similar in every way except for their layout. In Version A the passage was presented in continuous, run-on, prose, and in Version B the line endings (and beginnings) were determined by following the layout of Figure 1b. The reading age level of the text, according to the Flesch formula, was about 10 years. Figures 2a and 2b show the texts we used.

Please insert Figures 2a & 2b about here

Participants

Approximately 100 twelve-thirteen year old children from a local school participated in this experiment. The children were in four separate classes, and each class was deemed to be of equal ability by their head teacher.

Procedure

Each class participated in a different condition and there were four conditions in all, namely:

1 chunked text: slow recall

2 chunked text: fast recall

3 continuous text: slow recall

4 Continuous text: fast recall.

The two versions of the text were intercollated and the children were handed in order a copy of a text, face down. This procedure ensured that the allocation of the children to the two conditions was random. The children were told they had 'approximately 5 minutes' in which to read and learn the text and to prepare themselves to write it out. (They were actually given 4 minutes.) In conditions 1 and 3 they were told before they started to read the text, and again before they started to recall it, that they could take as long as they wished, that they could make corrections, and that there was no need to hurry. In conditions 2 and 4 the children were told that they should recall the text as quickly as they could, that crossing out would not matter, and that the aim was to get as much down on paper as quickly as

possible. In the experiment itself the recall sheets were handed out face-down with the texts and then, when the participants were asked to recall their texts, they were asked to put the original text materials face-down before they began. The participants were given as much time as they needed to recall their texts in all four conditions.

Finally, the participants completed the Keele Reading Comprehension Test (Hartley and Trueman, 1986) which is a cloze-type reading test (where respondents have to read passages of text and to fill in missing words). This is a timed test and the children were allowed ten minutes to complete as many items out of sixty as they could.

Results

The Keele Reading Comprehension Test was scored for all of the pupils, and it was used as a basis for matching children in the four groups to provide groups of approximately the same reading ability. (The mean scores for each group are shown in Table 2.)

The recall protocols were scored out of 50, using an especially prepared scoring sheet (see Appendix). The mean recall scores obtained for the four conditions are also shown in Table 2.

Please insert Table 2 about here

A two-way analysis of variance for independent subjects was used to analyse the recall data. The results showed that there was no

significant effect for the conditions ($F = 0.99$, df 1,84, $p = 0.32$), or for the speed of recall ($F = 0.75$, df 1,84, $p = 0.39$), and neither was there a significant interaction ($F = 1.21$, df 1,84, $p = 0.27$). Clearly these results show that chunking did not significantly affect the amount recalled, and neither did the speed of recall.

The next question of concern was whether or not the participants recalled the text in the format that they were initially presented with. Here the results too were clearcut. Of the 44 pupils who received the text in the chunked format, 44 recalled it in a chunked manner. Of the 44 pupils who received the text in the continuous format, nearly all of them recalled it in this manner. Three pupils showed some tiny forms of chunking - starting a new line for one of the wives and one pupil did this for two of the wives. In addition, seven pupils separated the last sentence from the remainder of the passage. The only other observation that can be made here was that 16 pupils left out the final sentence in the chunked recalls, whereas only 5 did so in the continuous text recalls.

Discussion

The first main finding in this experiment was that chunking did not lead to significantly superior recall. It is hard to explain why this should be so, given the results presented in Table 1. Of course, the text used in this experiment was both unusual and very short: perhaps different results might be obtained with different texts. A second finding was that in this experiment the recall results were not related to reading ability. (Product moment correlations between the amount recalled and reading ability, as

assessed by the Keele Test, were 0.09, -0.37, 0.15, and 0.33 for conditions 1 to 4 respectively, and none of these were statistically significant.)

The most important finding in this experiment was that the format of the text did affect the format of the recall. In this experiment what went in determined what came out! Such findings, if repeated with different texts and different conditions, are important. It would appear that the presentation of the text can have a marked effect on how people recall it. If the presentation is less than adequate then this may have long term consequences. Rothkopf, Koether and Billington (1992), for example, have shown that the way maps and diagrams are presented to readers can subtly affect their recall and performance, despite repeated and lengthy practice.

The last finding of this experiment was that the manipulation of the instructions concerning speed of recall had no significant effect on the outcomes. There was no indication that the proportion of respondents leaving out the last line of the text in the chunked recall condition varied in accordance with the instructions about speed of responding: the numbers leaving out this sentence were approximately the same in groups one and two. Indeed, my observations suggested that the instructions concerning speed of responding were observed by most of the children.

The main results of this experiment thus repeat the informal observations that I made initially with my university students and that I reported at the beginning of this paper. The <u>amount</u> recalled from the two styles of text did not differ, but the <u>format</u> of the text did determine the format of the recall.

Clearly further work is needed with different texts and, possibly, with mixed continuous-chunk presentations in order to see what effect these might have.

The experiments reviewed at the beginning of this paper, together with my own, lead me to conclude more generally that the interacting parameters most in need of systematic exploration in a program of study on chunked text are:

(1) the characteristics of the readers (e.g. age, ability, vocabulary skill, etc.);

(2) the characteristics of the text (e.g. underlying structure, relative difficulty, length, line widths, etc.);

(3) the characteristics of the measures used and how they are introduced (e.g. speed, search, comprehension, free recall, etc.).

Co-ordinating such a programme of research could perhaps clarify some of the sources of controversy concerning the efficacy of chunked text.

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Correspondence concerninq this article should be addresed to: James Hartley, Department of Psychology, Keele University, Keele, Staffordshire, ST5 5BG, U.K.

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Table 1
The results of studies on structured text.

Study	Conditions	Participants	Tasks	Results
Tinker (1955)	1 traditional layout 2 vertical text	college sophomores N=10	reading speed	negative results for vertical text
Coleman & Hahn (1966)	1 traditional layout 2 vertical text	1 2nd & 3rd graders N=16 2 students N=52 3 students N=28	1 multiple choice questions 2 multiple choice questions 3 tachistoscopic exposure times	negative results for vertical text
Coleman & Kim (1961)	1 traditional layout 2 vertical text 3 square span 4 phrase segmentation within lines 5 one phrase/line	under-graduates (8 experiments) N=267	1 words read/min. 2 questions answered A conventional reading B tachistoscopic text	no significant differences on comprehension but negative result for vertical on speed with A: vertical best for B
Andrews (1949)	1 traditional layout 2 square span	? n=12	reading speed	slight advantage for square span
Nahinsky (1956)	1 traditional layout 2 square span 3 phrase segmentation within lines	college students N=30	words/sentence from a tachistoscopic presentation	square span significantly better: traditional and phrase segments not significantly different

Klare, Nichols & Shuford (1957)	1 traditional layout 2 square span 3 phrase segmentation within lines	airmen N=533	1 reading speed 2 multiple choice test	traditional better on speed: high ability better on segmented text but low ability worse
North & Jenkins (1959)	1 traditional layout 2 square span 3 phrase segmentation within lines	university freshmen N=180	1 reading speed 2 comprehension 3 accuracy	segmented units superior on speed and accuracy, but no differences on comprehension: square span not significantly different from standard format
Stevens (1981)	1 traditional layout 2 slashes between phrases	high school sophomores N=85	comprehension test questions	significant advantage for chunked text for three ability levels
Gerrell & Mason (1983)	1 traditional layout 2 spaces between phrases within lines	fifth grade average or above in reading ability N=30	multiple choice comprehension questions	participants did significantly better with chunked text
O'Shea & Sindelar (1983)	1 traditional layout 2 5 spaces between thought units	good and poor readers at grades 1,2,3 N=83	1 oral reading errors 2 comprehension	segmentation helped both good and poor readers and especially helped slow but accurate readers
Patberg & Yonas (1978)	1 traditional layout 2 13 letter spaces between words	8th grade children N=96	1 reading speed 2 multiple choice questions	wide spacing hindered able readers but helped poorer ones
Jandreau et al (1986)	1 traditional layout 2 phrase segmentation within lines	college students 1 N=44 2 N=36	deletion of semantically odd words	both studies provide support for phrase segmentation

Cromer (1970)	1 traditional layout 2 vertical text 3 appropriately spaced phrases within lines 4 inappropriate spacing within lines	college freshmen N=64	1 reading time 2 recall scores on both reading aloud and silently	meaningfully spaced phrases helped poor readers who read word by word but not readers with inadequate vocabulary
Epstein (1967)	1 traditional layout 2 appropriately spaced phrases within lines 3 inappropriately spaced phrases within lines	psychology students N=96	recall of word strings	chunked material was easier to learn when text was appropriately structured
Anglin & Miller (1968)	1 appropriately segmented phrases on separate lines 2 inappropriately segmented phrases on separate lines	university students N=12	free recall 6 times	participants recalled significantly more from appropriately segmented phrases
Carver (1970)	1 traditional layout 2 chunked format 3 newspaper format	college students N=70	1 reading rate (wpm) 2 multiple choice questions	no significant effects
Hartley & Burnhill (1971)	1 traditional layout 2 line endings determined by syntactic units	psychology students N=49	1 amount read 2 recall questions	no significant differences on either measure
Frase & Schwarz (1979)	1 traditional layout 2 chunked format 3 inappropriate chunking	college students, 5 experiments, N=8,16,16,16,16	finding information	positive results for appropriate segmentation

Stone (1981)	1 traditional layout 2 chunked format	college students N=120	free recall	good readers helped by experimental layout, no differences for poor readers
Mason & Kendall (1979)	1 traditional layout 2 chunked format	4th grade students N=98	read a sentence and answer a question	positive results with chunking for low-ability readers, but chunking increased reading times
Weiss (1983)	1 traditional layout 2 chunked text based on pausal units 3 chunked text based on syntactic units	grade 4 children N=324 grade 7 children N=324	cloze test in traditional layout	significant advantage for the two chunking methods over the traditional format for three ability levels
Brozo, Schmelzer & Spires (1983)	1 traditional text 2 chunked text: units divided by slash lines	1 college students: good readers N=44 2 college students: good readers N=58	comprehension questions (easy text) comprehension questions (more difficult text)	chunked text slightly better but not significantly different on easy text chunked text significantly better on more difficult text
Keenan (1984)	1 traditional layout 2 chunked format (line lengths controlled) (difficult and easy passages)	clerical staff N=24	1 proof reading tasks 2 comprehension tasks	chunked read significantly slower than traditional for all tasks and at both levels of difficulty
Hartley (1980)	1 traditional layout 2 chunked format 3 vertical groupings	college students 1 N=54 2 N=36	finding information	no significant differences

Negin (1987)	1 traditional text 2 chunked text: units divided by slash lines	hearing impaired students: reading age 7 yrs N=20	multiple choice comprehension questions on expository texts and narrative passages	chunked text significantly improved performance on both the narrative and expository texts
Taylor, Wade & Yekovitch (1985)	1 traditional text 2 segmented text with one phrase/line both with practised or unpractised participants	5th grade students (good and poor readers) N=45	free recall followed by probed recall	practice had a significant effect on both measures of recall. For free recall practice helped good readers with segmented text, and poor readers with the traditional text. For probed recall practice also helped poor readers with the segmented text.
Beggs & Howarth (1985)	1 traditional layout 2 appropriate chunking with keywords stressed (in bold) 3 inappropriate chunking with keywords stressed (in bold)	children aged 8-10 yrs N=15	1 read text aloud 2 comprehension questions	positive results with appropriate chunking
Kirby & Gordon (1988)	1 traditional layout 2 vertical text 3 appropriate chunking 4 inappropriate chunking	children grades 3,4,5 & 6 N=352	multiple choice questions	poor readers benefited from appropriate chunking

Bever et al (1991)	1 traditional text (ragged right) 2 computer-based spacing: 1 phrase-tree controlled 2 phrase-structure 3 prosody-controlled	undergraduates N=80	delete odd word/short paragraph	significantly more words were crossed out in the phrase tree than the traditional, especially for less able students. Phrase structure and prosody treatments had no effect
Jandreau & Bever (1992)	1 traditional text 2 computer-based spacing: 1 additional spacing between words 2 phrase spaced (more space between phrases than between words)	college students of average and above average N=130	read 12 texts answer 10 multiple choice content questions on each text	average ability Ss did better on recall with phrase-tree format, but there were no significant differences for above average ability students. No significant effects on reading speed

b:structex.tab B16)

Table 2

The mean reading test scores (out of 60) and the mean recall scores (out of 50) for the continuous and the chunked text when it was recalled slowly or quickly. In this study no significant differences are apparent.

		Version A (continuous text)		Version B (chunked text)	
		slow recall	fast recall	slow recall	fast recall
Reading test score	x	25.8	25.5	25.2	27.3
	sd	7.8	7.8	8.6	6.8
	N	22	22	22	22
Recall score	x	37.4	36.9	37.2	41.4
	sd	9.5	8.7	10.8	10.0
	N	22	22	22	22

Figure 1a

Now the sons of Jacob were twelve. The sons of Leah; Reuben, Jacob's firstborn, and Simeon, and Levi, and Judah, and Issachar, and Zebulun. The sons of Rachel; Joseph, and Benjamin: And the sons of Bilhar, Rachel's handmaid; Dan, and Naphtali. And the sons of Zilpah, Leah's handmaid; Gad, and Asher. These are the sons of Jacob, which were born to him in Padan-aram.

Figure 1b

Now the sons of Jacob were twelve:
The sons of Leah;
Reuben, Jacob's firstborn,
and Simeon, and Levi, and Judah,
and Issachar, and Zebulun:
The sons of Rachel;
Joseph, and Benjamin:
And the sons of Bilhar, Rachel's handmaid;
Dan, and Naphtali:
And the sons of Zilpah, Leah's handmaid;
Gad, and Asher:
These are the sons of Jacob, which were born
to him in Padan-aram.

Figure 1. The materials used in informal experiments.

Version A

John had twelve sons, and four wives. Sheila's sons were; Ian, John's firstborn, and Brian, and Steven, and Mark, and Daniel, and Peter: Carol's sons were; David, and Andrew: And Catherine's sons were Philip, and Michael: And Julie's sons were; Paul and Keith. These are all John's sons, who were born in Manchester.

Version B

John had twelve sons, and four wives.
Sheila's sons were;
Ian, John's firstborn,
and Brian, and Steven, and Mark,
and Daniel, and Peter:
Carol's sons were;
David, and Andrew:
And Catherine's sons were;
Philip, and Michael:
And Julie's sons were;
Paul and Keith.
These are all John's sons, who were born in Manchester.

Figure 2. The materials used in the present experiment.

Appendix

Score Sheet

A	Count how many wives mentioned	up to 4
B	Give one mark for each wife correctly named	up to 4
C	Count how many sons named	up to 12
D	Give one mark for each son correctly named	up to 12
E	Did Sheila have six children named?	YES give 1
		No give 0
F	For each of Sheila's children named correctly give one mark	up to 6
G	Did Carol have two children named?	YES give 1
		No give 0
H	For each of Carol's children named correctly give one mark	up to 2
I	Did Catherine have two children named?	YES give 1
		NO give 0
J	For each of Catherine's children named correctly give one mark	up to 2
K	Did Julie have two children named?	YES give 1
		NO give 0
L	For each of Julie's children named correctly give one mark	up to 2
M	Did the subjects say Ian was John's firstborn?	YES give 1
		NO give 0
N	Did they mention Manchester?	YES give 1
		NO give 0

Maximum Score = 50 marks