

Experiments with Unjustified Text

James Hartley and Peter Burnhill

Three separate experiments are described in which various settings of unjustified text are compared: (1) passages with line endings determined by syntactic considerations were compared with passages set in a standard unjustified form; (2) passages with approximately one-third of the lines ending with hyphenated words were compared with the same standards; (3) unjustified double-column formats of different widths were compared with each other. No significant differences in reading speed were found in any of the three experiments, although a significant sex difference was found in Experiment 3 when a scanning method was used. No significant differences were found in comprehension scores. Attitudes expressed by students in Experiments 1 and 3 tended to favor the shorter lines with more uneven endings.

If the reader examines any textbook in front of him, he will most probably observe that the right-hand margin of the text is straight: that the lines of type are forced—by variable word spacing and by the use of hyphens—into what printers call “justified” text. An alternative strategy to this procedure is that adopted in the presentation of this article, that is, to provide equal spacing between the words, and consequently to produce line lengths that are irregular—or “unjustified” text.

The argument of this paper is that there is, in fact, little—apart from tradition—to justify justified text. When a typographical sign (say a lower-case roman *s*) of a particular sort (set, font) is repeated in the context of a meaningful sequence of signs, we expect the dimensional attributes of the sign to be consistent at every appearance. If it does not appear so (say in proof reading), we replace it by a sign of the correct sort. In a sentence the particular sign we use to group signs meaningfully is, by convention, the *absence* of a mark; and we call this “not-mark” sign a word space. We could replace this not-mark sign by a particular sign; and, if we did so, we would expect it

to be dimensionally consistent at every appearance. If it was not, we would replace it by a sign of the correct sort. The fact that we prefer to use a “not-mark” sign does not change the need for particular signs to be dimensionally consistent.

Justifying the text, therefore, causes unco-ordinated word spaces, whereas unjustified text is the result of co-ordinating the sign system. It might be more appropriate to think of justified and unjustified text as “unco-ordinated” and “co-ordinated” word space systems. If we accept the argument for the standardization of the interval between words in the context of a sentence and if we agree that not-marks are signs of a particular sort, we can go on to examine the implications of the argument for the joints which occur between other groups of signs in the hierarchical structure of the language. Alternatively, of course, we are free to continue the irrational practice of unco-ordinated spacing.

Unjustified text is now becoming common where cheap and rapid printing is required—in reports of conference proceedings, and in newspapers. Evers (1968) reports—with reference to *Rotterdamsch Nieuwsblad*, a Dutch evening newspaper—that there have been “considerable savings in the composing room, a production benefit of 13.5% in the perforating department, and (less clearcut and to a less extent) appreciable savings in the casting department.” Spencer’s (1969) textbook, *The Visible Word*, provides an illustration of the technique, together with a review of typographical research. Zachrisson (1965) cites evidence to show that unjustified text is read as quickly as justified text (Hultgren, 1954; Powers, 1962), and he suggests that unjustified text is read more quickly by less proficient readers. Other investigators have reported similar findings of no significant difference between the two typesettings (Davenport and Smith, 1965; Wiggins, 1967; Fabrizio, *et al.*, 1967). Becker, *et al.* (1970) found no differences between the preferences of American college students for justified or unjustified setting, although this finding contradicts that of Ruthenbeck (1965).

If it is accepted that unjustified text is read as quickly as justified text, then future questions will concern themselves with whether some methods of setting unjustified type might lead to more efficient reading than others. The experiments to be reported in this paper examine three issues. The first of these is a comparison study between

standard unjustified text and text where line length is determined by grammatical constraints. The second experiment compares standard unjustified text with text where approximately 33% of the lines end with a hyphenated word. The third experiment examines the effects of unjustified double-column formats with different overall widths. Table I illustrates samples from the experimental texts.

Experiment One

The aim of this experiment, in the light of recent work in psycholinguistics which has shown that syntactical units are important in the understanding of sentences (e.g., Miller, 1962; Miller & McKean, 1964; Fodor & Bever, 1965; Epstein, 1967; Anglin & Miller, 1968), was to see if a grammatical determination of line length would speed up, or slow down, reading speed; and whether or not comprehension would be affected. Two passages of approximately equal length (2500 words) and difficulty were obtained; these were scripts of two Radio Three broadcasts prepared by the same author (McInnes, 1965 and 1969). Two versions of each passage were typed out and duplicated (Table I): (i) the standard—Example 1; and (ii) the experimental—Example 2—similarly produced but with line lengths determined by grammatical constraints. In brief, lines stopped between syntactic units rather than within them. (This procedure was easily done—reflecting the fact that secretaries can intuitively recognise syntactical units although they may have forgotten all about “grammar.”) Following each passage—in order to test comprehension—were appended a series of questions, demanding short written answers. These questions related to material covered in the first five pages of the passage (which was approximately seven foolscap pages long). A total of eight marks was available for each test.

Procedure. The experiment was carried out in a group setting with volunteer students, following a first-year psychology lecture. A standard balanced experimental design was employed by allocating students at random into four conditions:

- | | |
|--------------------------------------|-------------------------------------|
| Condition 1. Passage A, Standard | followed by Passage B, Experimental |
| Condition 2. Passage A, Experimental | followed by Passage B, Standard |
| Condition 3. Passage B, Standard | followed by Passage A, Experimental |
| Condition 4. Passage B, Experimental | followed by Passage A, Standard |

TABLE I. Examples of materials used in the experiments.

Example 1. (The standard)

Moreover, not only have so many historians concentrated their attentions on individual sects, but increasingly they have tended to study these sects from one particular standpoint - from a sociological point of view. The differing sects are seen as representing differing social groups or social movements, the theology of the sect being an ideological

Example 2. (Grammatically terminated lines)

Moreover, not only have so many historians concentrated their attentions on individual sects, but increasingly they have tended to study these sects from one particular standpoint - from a sociological point of view. The differing sects are seen as representing differing social groups or social movements, the theology of the sect being an ideological superstructure,

Example 3. (Moderate hyphenation)

Moreover, not only have so many historians concentrated their attentions on individual sects, but increasingly they have tended to study these sects from one particular standpoint - from a sociological point of view. The differing sects are seen as representing differing social groups or social movements, the theology of the sect being an ideological superstructure,

Each student was provided with the two passages fastened together. The instructions given were as follows:

“When I say ‘Start’ I want you to read the first passage in front of you *as naturally as possible*. There are a few simple questions to answer at the end of the passage, only four or five, and they are not

Example 4.

have worked on the period. Each individual sect has found its chronicler who has explored its theology and examined its history in loving detail. George Yule, for example, has written on the Independents, Brailsford on the Levellers, Braithwaite on the Quakers, and so on.

Moreover, not only have so many historians concentrated their attentions on individual sects, but increasingly they have tended to study these sects from one particular standpoint – from a sociological point of view. The differing sects are seen as representing differing social groups or social movements, the theology of the sect being an ideological superstructure, a rationalization of the group's economic aims. For example, Norman Cohn in his brilliant and

are in danger of missing, or at any rate obscuring the main point. The central feature of seventeenth-century religious history is, indeed, not so much what was happening to the individual sects, that is to religions in the plural, but rather what was happening to Christianity as a whole – in other words to religion in the singular. And, in order to understand what was going on in this second sphere, it is essential to glance briefly at the place of religion in medieval society.

In the Middle Ages religion formed a total backcloth to all human activity. Every aspect of life was simply a projection, an extension of religion. Art for example. The greatest artistic achievement of the Middle Ages was in the building of cathedrals. Music

Example 5.

the period. Each individual sect has found its chronicler who has explored its theology and examined its history in loving detail. George Yule, for example, has written on the Independents, Brailsford on the Levellers, Braithwaite on the Quakers, and so on.

Moreover, not only have so many historians concentrated their attentions on individual sects, but increasingly they have tended to study these sects from one particular standpoint – from a sociological point of view. The differing sects are seen as representing differing social groups or social movements, the theology of the sect being an ideological superstructure, a rationalization of the group's economic aims. For example, Norman Cohn in his brilliant and learned book *The Pursuit of the Millennium* has argued, that Anabaptism was the religion of the displaced peasantry and the disoriented urban poor. These groups, Cohn maintains, rootless and cast out from traditional society, found identity in the total solution of a revolutionary chiliasm. A still more striking instance of this sociological approach is the Tawney-Weber thesis. Both R. H. Tawney and Max Weber

What is true in the sphere of art is true in all other spheres in the Middle Ages. Economic relations were governed by the Christian ideal of the just price. Kings were also priests. They were given divine powers at their coronation. Churchmen played a key role in government. Religion in the Middle Ages was totalitarian. It compromised every aspect of life.

The profound thing which happened to religion in the seventeenth century was that it ceased to occupy this position of being a total backcloth to all human activity. Gradually, religion disengaged itself from the world around it and retracted into its own compartment. From being everything it became only a part of life, separated off and distinct from other parts of life. It was in the seventeenth century that men ceased to believe in the idea of the just price. In the seventeenth century, too, one can discern religion without withdrawing from the sphere of art. Music ceases to be simply polyphony; the first operas were performed in England in the Commonwealth period. The typical medieval poem was a didactic poem. It was designed to justify the ways of God to man. On the surface *Paradise Lost* seems to be well within this

difficult to do. Try to read the passage as though you were reading a novel. I shall tell you when to stop after a certain amount of time.’’ The students were stopped after seven minutes and were asked to mark clearly on the passage how far they had read. They were then allowed as much time as they liked to complete the test questions.

This procedure was then repeated for the second passage. After completing the second test, the students were asked to indicate on the back of the last test sheet their sex and their answers to the following questions, which were given orally: 1. Which passage did you prefer to read, A or B? 2. [After being shown the differences between the layout of the passages] Which layout do you prefer, 1 or 2? 3. Why? State the reason for your choice. The aim of questions 2 and 3 was to ascertain directly what the students thought about the layouts, whereas that of question 1 was to ascertain *indirectly* whether the layout had had any effect on expressed preferences.

Results. The main results of the experiment are shown in Table II, and speak for themselves. There was no significant difference between the number of words read in either version of the passages, there was no significant difference between the comprehensions scores, and there was no significant difference between the results obtained by either sex.

In response to question 1, the experimental versions of the passages were preferred to the standards, but this difference was not significant. In answer to question 2, 12 subjects preferred the standard versions of the passages, 19 the experimental versions, but 18 expressed no preference. Quite marked and contrasting statements were made in response to question 3: e.g., a subject preferring the standard passage wrote, "For appearance, this is much more acceptable"; a subject preferring the experimental passage wrote, "A sheet of evenly-spaced writing puts me off at the very beginning."

Discussion. One of the consequences of using grammatical constraints to determine line lengths was that, although the mean line lengths were the same, the experimental passage had a much more uneven right-hand margin than had the standard (see Table I). Indeed, if the experiment had produced statistically significant differences, a second experiment would have been needed to determine whether or not it was the uneven line length rather than the grammatical constraints that had caused the differences. This second experiment, however, was not necessary. It can be concluded, therefore, that these subjects were not restricted by a wide variety of line length in unjustified text, or by grammatical considerations.

TABLE II. The means and standard deviations obtained by the two groups on two measures: (i) number of words read and (ii) comprehension score.

		<i>Standard Passage Unjustified Text</i>		<i>Experimental Passage Syntactically Justified Text</i>	
		<i>Number of Words read</i>	<i>Comprehension Score</i>	<i>Number of Words read</i>	<i>Comprehension Score</i>
Men	\bar{X}	1855	4.44	1859	4.74
(N = 27)	sd	394	1.31	408	1.43
Women	\bar{X}	1812	4.27	1792	4.45
(N = 22)	sd	303	1.21	248	1.41
Total	\bar{X}	1836	4.37	1829	4.61
(N = 49)	sd	356	1.27	346	1.42

These findings are similar to those reported by Carver (1970). Carver's three experiments (published after the completion of our own) also examined the readability of text with line endings determined by syntactical considerations (and a double space between syntactic units). Carver also found—using a more sophisticated electromechanical device for recording reading speed—no significant differences between conventional typesetting and a variety of other settings of syntactically justified type.

Experiment Two

The aim of this experiment was to see if the presence of hyphens at the end of lines would slow down reading speed, and affect comprehension. In a pilot study conducted by some of the writers' students, it was found that with 100% hyphenation, reading speed was markedly slowed down for 8 out of 10 subjects (reading a single page of prose material). However, 100% hyphenation is rare and it looks very peculiar; it was thought that it would be better to experiment with a more usual amount. Accordingly, therefore, two versions of the passages utilized in Experiment One were prepared, (i) the standard, and (ii) the experimental—with approximately 33% of lines ending with hyphenated words (Table I, Example 3).

The procedure for this experiment was the same as that for Experiment One except that the reading time allowed was six minutes instead of seven. (Four subjects completed reading one of the passages with the latter time in Experiment One.) An additional

question was asked after the experiment in order to ascertain whether any of the subjects had noticed the difference between conditions. First- and third-year psychology students in laboratory classes were the subjects.

Results. The main results of this experiment are shown in Table III and, again, speak for themselves. There was no significant difference between the mean number of words read for either version of the passages, nor were there any differences in comprehension scores. As before, there were no significant differences between the results obtained by either sex.

Response to oral question 1 indicated that 33% hyphenation had no measurable effect upon preference. This finding was reflected in the responses to the additional oral question: not one subject reported having noted any difference between the standard and the experimental versions of the passages. However, in answer to question 2 (which to some extent was a leading one), 24 subjects preferred the standard, 10 the experimental, and 8 expressed no preference. (This difference was significant.) Again, marked and contrasting statements were made in response to question 3: e.g., a subject preferring the standard wrote, "It is easier to read words as whole units—I find hyphens confusing"; one subject, preferring the experimental version, wrote, "Hyphens allow speedy transference from line to line and prevent you losing your train of thought."

TABLE III. The means and standard deviations obtained by the two groups on two measures: (i) number of words read, and (ii) comprehension score.

		<i>Standard Passage Unjustified Text</i>		<i>Experimental Passage 33% hyphenated</i>	
		<i>Number of Words read</i>	<i>Comprehension Score</i>	<i>Number of Words read</i>	<i>Comprehension Score</i>
Men	\bar{X}	1672	4.79	1582	5.11
(N = 19)	sd	347	1.20	348	1.62
Women	\bar{X}	1463	5.43	1525	5.26
(N = 23)	sd	306	1.17	299	1.39
Total	\bar{X}	1588	5.14	1551	5.19
(N = 42)	sd	341	1.23	323	1.50

Discussion. These results indicate that the proportion of hyphens used did not affect in any measurable way the reading speed or comprehension. This finding replicates that of Davenport and Smith (1965). The response to question 3 did suggest—although the subjects did not notice any difference between conditions when reading them—that when the standard and experimental passages were placed side by side they did prefer the overall appearance of the passages without hyphens.

It would seem valid to conclude from this experiment, therefore, that text without hyphenation is read as efficiently as text with a moderate amount, and that readers are unlikely to notice the difference. In view of the fact that hyphenation decisions, together with the extra key strokes required to put in hyphenation, can increase printers' setting time by as much as 25%, it would seem reasonable to suggest that printers might conveniently abandon such a practice. It is interesting to reflect at this point that computer programs are now being written which perpetuate the practice of hyphenation and justification.

Experiment Three (a)

The materials used in the experiments described so far have been typewritten cyclostyled sheets, and it may well be argued that students are used to a variety of layouts with such materials. In the following experiment, however, printed extracts from the passages were used.

Much research has been done with justified text on line length, and the relative merits of a single or two-column format (see Foster, 1970, for references), but as far as the authors are aware, these issues have not been examined with unjustified text. In this experiment two versions of extracts from the passages previously used were prepared and printed. In brief, one version utilised a two-column format with short line lengths (approximately 50 mm. each) and the other version utilised longer line lengths (approximately 85 mm. each). Both passages were printed in each version (Table I, Examples 4 and 5). In more technical detail, each text was printed in letterpress, Monotype Baskerville, Series 169, 9-point 9 set, cast on a 10-point body. New paragraphs were shown by a one-line space, with no indentation. Word space was standard throughout at 4 units of

set. One version of the text had maximum permissible line lengths of 13 pica ems, the other 20 pica ems—both had an inter-column space of 1 pica em. Line length was determined by the rule that breaks would occur at the point when no more words could be fitted by the machine compositor to the line without hyphenation.

The differences in line length in this experiment were not just arbitrarily chosen. Both measures can be used with a standard A4 (210 mm. × 297 mm.) page size, although the length of 13 ems is more usual in a three-column structure. The relationship can be seen more clearly in that three columns of 13 ems with 1 em inter-column space produces an information area 41 ems wide (approximately 173 mm.) and that two columns of 20 ems each with 1 em inter-column space also totals 41 ems.

The experiment followed the same general pattern as before, except that in this experiment the reading time allowed was 2½ minutes, and no test questions were asked. Subjects were informed that there would be no test questions, and that simply “natural reading speed” was being assessed. Following the experiment the standard questions were repeated. In this experiment College of Education students were used as subjects.

Results. The main results of this experiment are shown in Table IV, and like the others, largely speak for themselves. There was no significant difference between the mean number of words read for either version of the passages, nor was there any significant differences between the results obtained by either sex.

Experiment Three (b)

It has been argued in previous research that reading speed over such a short period of time is not a particularly sensitive measure to use, and in particular that a *scanning* measure might be more appropriate (see Foster, 1970). Accordingly, therefore, the above experiment was repeated utilising such a method as described by Poulton (1967). Subjects were provided with the passages, and with lists of phrases from them, each phrase having a word omitted. Subjects' task was to scan the text for target phrases and write in the missing word on the response sheet. Phrases were selected from successive parts of the text at approximately equal intervals, thus the more the subjects

TABLE IV. The means and standard deviations obtained for the double-column format with different line lengths, using two measures; (i) reading speed and (ii) scanning score.

		<i>Double-Column Format with Short Line Length (Maximum possible, 13 ems)</i>		<i>Double-Column Format with Long Line Length (Maximum possible, 20 ems)</i>	
		<i>Number of Words Read</i>	<i>Scanning Score</i>	<i>Number of Words Read</i>	<i>Scanning Score</i>
Men	\bar{X}	619	7.58	656	7.31
	sd	160	2.56	192	2.15
	N	10	19	10	19
Women	\bar{X}	588	10.36	584	9.86
	sd	87	2.44	151	2.00
	N	19	14	19	14
Total	\bar{X}	599	8.76	609	8.39
	sd	118	2.86	170	2.44
	N	29	33	29	33

read in the time available, the higher their scanning score. As before, each subject was allocated at random into one of the four experimental conditions. They were instructed that they were to scan the text and write in the missing words, and that they would be given a set period of time in which to do this ($2\frac{1}{2}$ minutes). It was emphasised that there would be no test questions afterwards, and that the phrases were in order. Following the completion of the scanning of the two passages, subjects were asked the standard questions. Subjects in this experiment were first-year psychology students attending a laboratory class.

Results. The results of this experiment are also shown in Table IV; again, they are clearcut. There was no significant difference between the mean scanning scores obtained for either version of the passages, but there were marked sex differences: the women students scoring significantly more than the men ($p < .01$ in both cases).

An analysis of responses to the standard questions given after these experiments indicated that within the subgroups of College of Education students and under-graduates, the results were substantially similar. Answers to question 1 (Which passage did you prefer, A or B?), the indirect preference measure, indicate that overall there

was a preference for the shorter line length, and this difference was significant. In answer to question 2 (Which layout do you prefer?), 37 subjects preferred the double-column format with the short lines, 24 the longer lines, and one expressed no preference. It is perhaps worth observing at this point that the undergraduates were more disposed towards the shorter line lengths than were the College of Education students. Again, marked and contrasting statements were made in response to question 3, although, generally speaking, the short lines were preferred because they were "easier to read." Some subjects commented that scanning was easier with short lines, "Your eyes only need to go in one direction: down"; although, of course, opposite views were expressed, "With longer lines I could scan more in the same time."

Discussion. The main finding in these two related experiments was that line length did not affect reading speed—when measured by word counts, or by scanning. It is difficult to relate this finding to previous research, for such research has used justified text. An inspection of Examples 4 and 5, Table I, show the unjustified settings produced quite irregular line lengths. Burt (1959) using justified text, reported that (for 10-point type) line lengths shorter than 20 ems retarded reading speed, although these findings contradicted those of Paterson and Tinker (1940). Poulton (1959) found that single-column arrangements were read more rapidly than double-column ones, but he altered the type-sizes in producing the different versions of his passages. Foster (1970) showed, using the same type size, that a double-column justified format (line lengths of 17 picas) was read more quickly than a single-column justified format (line length 36 picas).

Foster (1970) measured the differences found in his experiment by the scanning method. It is not clear from the results obtained in our experiment that scanning is a more sensitive measure than reading speed. Clearly, overall, there was no measurable difference produced by the reading speed or the scanning measure, yet there was a sex difference with the scan procedure which was not found with reading speed. It would seem, then, either that scanning is more sensitive or that it is setting subjects a different task, one which is susceptible to sex differences. No previous investigation, to our

knowledge, has reported sex differences with the scanning measure, and few of them say whether or not they used one sex or both for their subjects.

Concluding Remarks

These experiments taken together would seem to indicate that unjustified text is robust: that is, it can be quite markedly manipulated without affecting reading speed or comprehension. Furthermore, the attitudes expressed have tended to favor the shorter and the more uneven lines.

Such conclusions are, of course, over-generalizations from limited studies. In the first two experiments the passages were typed rather than printed, and students (well used to a variety of typing styles) were employed as subjects. Furthermore, the conditions of the experiments were all kept very simple. Typography is remarkable for its number of variables—all of which interact—i.e. size and style of type, spacing between words and lines, line length, etc. Systematic research, varying one or two features at a time, ignores this complexity. Looking to the future, one needs to consider the relationships between the content of the material, its typesetting, and methods of assessing efficiency. Short lines may be a more appropriate way of setting—and scanning a more appropriate measure to use—when the material is more disconnected than that used in the experiments described, and when speedy retrieval of information (e.g., from a catalogue) is the prime requirement rather than comprehension.

Finally, it might be considered, in view of our introductory remarks, that researchers' and printers' concern over line endings is misplaced. Perhaps more attention should now be focused on general layout, relative to the kinds of material being printed, and, in particular, attention should be drawn to the relative position of the *beginning* of textual elements. It is indeed remarkable that, when our reading convention is from left to right, we spend most of our time considering how to end rather than where to start.

Acknowledgment. One of us (JH) is in receipt of a research grant from the Social Science Research Council, which he gratefully acknowledges.

REFERENCES

- Anglin, J. S. & Miller, G. A. The role of phrase structure in the recall of meaningful verbal material. *Psychonomic Science*, 1968, *10*, 343–344.
- Becker, D., *et al.*, Reader preferences for typeface and leading. *Journal of Typographic Research*, 1970, *IV*, 1, 61–66.
- Burt, C. *A Psychological Study of Typography*. Cambridge: Cambridge University Press, 1959.
- Carver, R. P. Effect of “chunked” typography on reading rate and comprehension. *Journal of Applied Psychology*, 1970, *54*, 3, 288–296.
- Davenport, J. S. & Smith, S. A. Effects of hyphenation, justification and type size on readability. *Journalism Quarterly*, 1965, *XLII*, 382–389.
- Epstein, W. Some conditions of the influence of syntactical structure on learning. *Journal of Verbal Learning and Verbal Behavior*, 1967, *6*, 415–419.
- Evers, C. H. Adjustment to unjustified composition on the *Rotterdamsch Nieuwsblad*. *Journal of Typographic Research*, 1968, *II*, 1, 59–74.
- Fabrizio, R., *et al.* Readability as a function of the straightness of right-hand margins. *Journal of Typographic Research*, 1967, *1*, 1, 90–95.
- Fodor, J. A. & Bever, T. G. The psychological reality of linguistic segments. *Journal of Verbal Learning and Verbal Behavior*, 1965, *4*, 414–420.
- Foster, J. J. A study of the legibility of one- and two-column layouts for BPS publications. *Bulletin of the British Psychological Society*, 1970, *23*, 79, 113–114.
- Hultgren, K. Experiment reported in Zachrisson, B. *Legibility of Printed Text*. Stockholm: Almqvist & Wiksell, 1965.
- McInnes, A. J. D. M. The shifting centre. *The Listener*, 1965, *LXXIII*, 1875, pp. 333 and 337.
- McInnes, A. J. D. M. Augustan politics: a reassessment. Radio Three Broadcast: September, 1969.
- Miller, G. A. Some psychological studies of grammar. *American Psychologist*, 1962, *17*, 748–762.
- Miller, G. A. & McKean, K. O. A chronometric study of some relationships between sentences. *Quarterly Journal of Experimental Psychology*, 1964, *16*, 297–308.
- Paterson, D. G. & Tinker, M. A. *How to Make Type Readable*. New York: Harper, 1940.
- Poulton, E. C. Effects of printing types and formats on the comprehension of scientific journals. Cambridge: MRC Applied Psychology Research Unit Report No. 346. 1959.
- Poulton, E. C. Skimming (scanning) news items printed in 8-point and 9-point letters. *Ergonomics*, 1967, *10*, 6, 713–716.
- Powers, J. P. Experiment reported in Zachrisson, B. *Legibility of Printed Text*. Stockholm: Almqvist & Wiksell, 1965.
- Ruthenbeck, K. E. Experiment cited by Warr, P. B. & Knapper, C. *The Perception of People and Events*. London: Wiley, 1968.
- Spencer, H. *The Visible Word*. London: Lund Humphries, 1969.
- Wiggins, R. H. Effects of three typographical variables on the speed of reading. *Journal of Typographic Research*, 1967, *1*, 1, 5–18.
- Zachrisson, B. *Legibility of Printed Text*. Stockholm: Almqvist & Wiksell, 1965.