

Whether a Reader Lands on the Wrong Line Is Set Not by the Line Spacing but by Its Ratio to the Line Length

— 30 em at 1.2 em and 60 em at 2.4 em give exactly the same chance — the pitch needed to hold the chance to 0.01 is 0.051517 times the line length, so longer lines need proportionally wider spacing — the separator is whether one asks about the spacing or about its ratio to the line length — [Paper 858]

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— *From thinking to syncing.* —

Abstract

Readability guidance often names one number for line spacing. This paper counts that the number cannot be fixed without the line length. No new theorem or law is claimed. First, at the same spacing, longer lines are misread more: at a 1.2 em pitch the chance is 6.334248×10^{-5} for 15 em lines and 1.824224×10^{-1} for 45 em (Section 2). Second, the gap is orders of magnitude: the ratio between 45 em and 15 em is **2879.938217** (Section 2). Third, and this is the core. The same ratio gives the same chance: 30 em at 1.2 em and 60 em at 2.4 em agree with difference 0 (Section 3). Fourth, the spacing needed is proportional to line length: holding the chance to 0.01 needs a pitch of **0.051517** times the line length (Section 3). Fifth, one number does not suffice: 0.772749 em suffices for 15 em lines, 2.318246 em is needed for 45 em (Section 3). Sixth, the separator is whether one asks about the spacing or about its ratio to the line length: fixing the spacing alone leaves misreading free to change with the line length (Section 4). **Keywords:** line spacing, line length, misreading, normal distribution, ratio, model.

Scope of this paper (scope note): No new theorem or law is claimed: that the return sweep to the next line can land on the wrong line, that longer lines are held to need wider spacing, and the tail probabilities of the normal distribution, are all known. No real typesetting rule is claimed: setting the vertical scatter at 0.01 of the sweep distance is a model, not a measurement of any typeface or reader. Reading speed is not treated: speed and comprehension are not the subject; only the chance of landing on a neighbouring line is examined. Type size and letter spacing are not included: all lengths are in em, and letter shapes are not treated. Vision research is not entered: measured eye movements and how peripheral vision finds the next line are not treated. Relation to earlier papers: Paper 848 showed that an index dividing weight by the square of height moves with height even at the same build. This paper stands beside it: there the answer moves with which power one divides by, here it is set by what one compares with. Paper 300 showed that whether two things share a root is decidable: the spacing and its ratio to line length are distinct roots by that criterion. What is added is laying out the chance for three line lengths, confirming that scaling length and spacing together leaves the chance unchanged, measuring that the spacing needed for 0.01 is proportional to length, and placing the separator on spacing versus ratio.

1. Notation and the Question

Setting: let L be the line length and s the line pitch (centre to centre), both in em. On the return sweep from line end to the next line's start, the vertical landing point is taken to scatter normally with standard deviation $\sigma = kL$, proportional to the distance travelled.

$$P(\text{neighbouring line}) = \operatorname{erfc}\left(\frac{s/2}{\sqrt{2} kL}\right), \quad k = 0.01$$

A vertical error beyond half the pitch lands on a neighbouring line.

Question: is misreading set by the spacing or by the line length?

2. Same Spacing, Different Lengths

Computation 2.1: with the pitch held at 1.2 em, the line length was varied.

line length	chance of a neighbouring line
15 em	6.334248×10^{-5}
30 em	4.550026×10^{-2}
45 em	1.824224×10^{-1}

Observation 2.2

at the same spacing, longer lines are misread more. The ratio between 45 em and 15 em is 2879.938217: a longer sweep scatters further vertically and more easily exceeds half the same pitch.

3. Set by the Ratio

Computation 3.1: line length and pitch were scaled together.

length, pitch	chance
30 em, 1.2 em	$4.550026390 \times 10^{-2}$
60 em, 2.4 em	$4.550026390 \times 10^{-2}$
difference	0

Observation 3.2

this is the core. The same ratio gives the same chance. Only s/L enters, and the difference is 0: a single spacing figure gains meaning only when paired with the line length.

Computation 3.3: the pitch holding the chance to 0.01 was found (two-sided one-per-cent point $z = 2.575829$).

line length	pitch needed	relative to line length
15 em	0.772749 em	0.051517
30 em	1.545498 em	0.051517
45 em	2.318246 em	0.051517

Observation 3.4

the spacing needed is proportional to line length. All three are 0.051517 of the line length: narrow spacing suffices for short lines and falls short for long ones.

4. The Separator

Observation 4.1

the separator is whether one asks about the spacing or about its ratio to the line length. Fixing the pitch at 1.2 em, a change from 15 em to 45 em lines changes the chance by 2879.938217. What must be fixed is not one number but a ratio.

Observation 4.2

placed beside Paper 848.848 showed that dividing weight by height squared moves with height even at the same build. There the answer moves with the power one divides by; here it is set by what one compares with. In both, one quantity alone is not enough; it needs a partner. Paper 300 showed that whether two things share a root is decidable: spacing and ratio are distinct roots by that criterion.

Observation 4.3

what is not said. Real typesetting rules, reading speed, letter shapes and measured eye movements are not treated. What is shown is that misreading is set by a ratio.

5. Census and Closing

1. scatter **0.01** of the sweep (Section 1): **a model**.
2. **15 em**: 6.334248×10^{-5} (Computation 2.1): **short lines**.
3. **45 em**: 1.824224×10^{-1} (Computation 2.1): **long lines**.
4. ratio **2879.938217** (Observation 2.2): **orders apart**.
5. same ratio, difference **0** (Computation 3.1): **the core**.
6. only s/L enters (Observation 3.2): **set by the pair**.
7. needed pitch **0.051517** of length (Computation 3.3): **proportional**.
8. **15 em** needs **0.772749 em** (Computation 3.3): **narrow suffices**.
9. **45 em** needs **2.318246 em** (Computation 3.3): **wide needed**.
10. spacing, or ratio (Observation 4.1): **the separator; Papers 848, 300**.

Closing: Whether a reader lands on the wrong line is set not by the line spacing but by its ratio to the line length. With the return sweep's vertical scatter at 0.01 of its length, a 1.2 em pitch gives 6.334248×10^{-5} for 15 em lines and 1.824224×10^{-1} for 45 em, a ratio of 2879.938217: a longer sweep scatters further and more easily exceeds half the same pitch. And 30 em at 1.2 em and 60 em at 2.4 em give the same chance with difference 0, while the pitch holding the chance to 0.01 is 0.051517 of the line length at every length, because only s/L enters the formula. So fixing the spacing with one number leaves misreading free to change with the line length. Placed among the earlier papers: beside Paper 848's "the answer moves with the power one divides by", as "the answer is set by what one compares with", and treating spacing and ratio as distinct roots by the criterion of Paper 300. To be honest: the scatter of 0.01 is a model value, not a measurement of any typeface or reader.

References

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