Supplementary Material

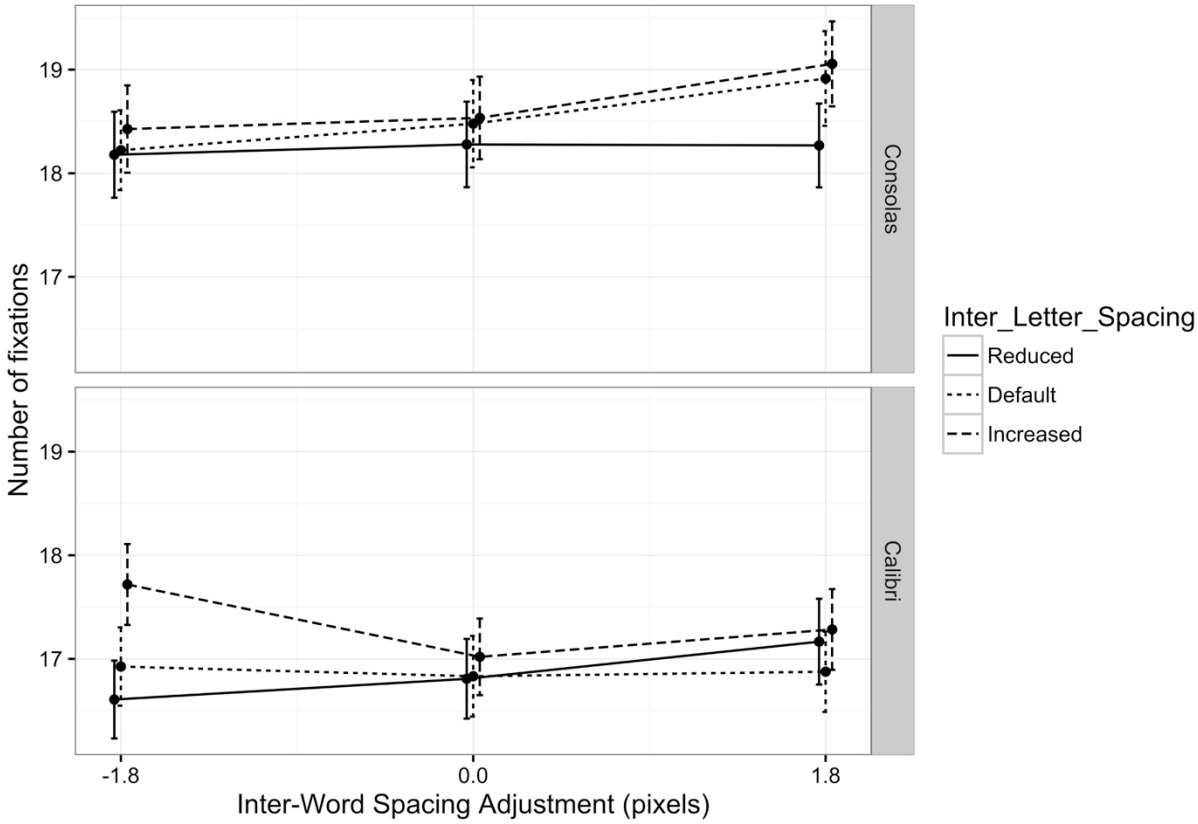
Eye movement recording of passage reading results in a rich data stream. In Experiment 3 of the main article we presented only a subset of the standard dependent measures often presented with in such studies. Here we present analyses of some additional measures: number of fixations, average fixation duration, and target word skipping rate. We also explore how reading skill, assessed by participant's effective reading rate, influenced the optimal spacing conditions.

Reading rate is composed of two eye movement measures: number of fixations, and average fixation duration. It is possible for tradeoffs to exist between these two measures that balance each other out when it comes to reading rate (i.e. longer fixations but fewer fixations in one condition). Examining the number of fixations and average fixation duration measures can also be diagnostic with regard to how effects in reading rate are manifested. The data for these two measures were analyzed with the same LMM models used for the effective reading rate data.

Number of Fixations: There was a main effect of font as readers made more fixations during their reading of sentences rendered in Consolas than in Calibri, b = 1.47, SE = .097, t = 15.07. There were also linear effects of both inter-word spacing, b = .174, SE = .075, t = 2.31, and inter-letter spacing, b = .319, SE = .074, t = 4.32, as larger spacing resulted in more fixations. The linear effect of inter-word spacing, interacted with font, b = .314, SE = .145, t = 2.16, as the effect was larger for Consolas than for Calibri. Finally, there was a significant three-way interaction between font, and the linear components of inter-word and inter-letter spacing, b = .796, SE = .252, t = 3.16. This interaction is due to opposite patterns of spacing effects for the two fonts (see Figure 1S). For Consolas, the effect of inter-letter spacing grew

stronger with increasing inter-word spacing. For Calibri, the effect of inter-letter spacing grew stronger with decreasing inter-word spacing.

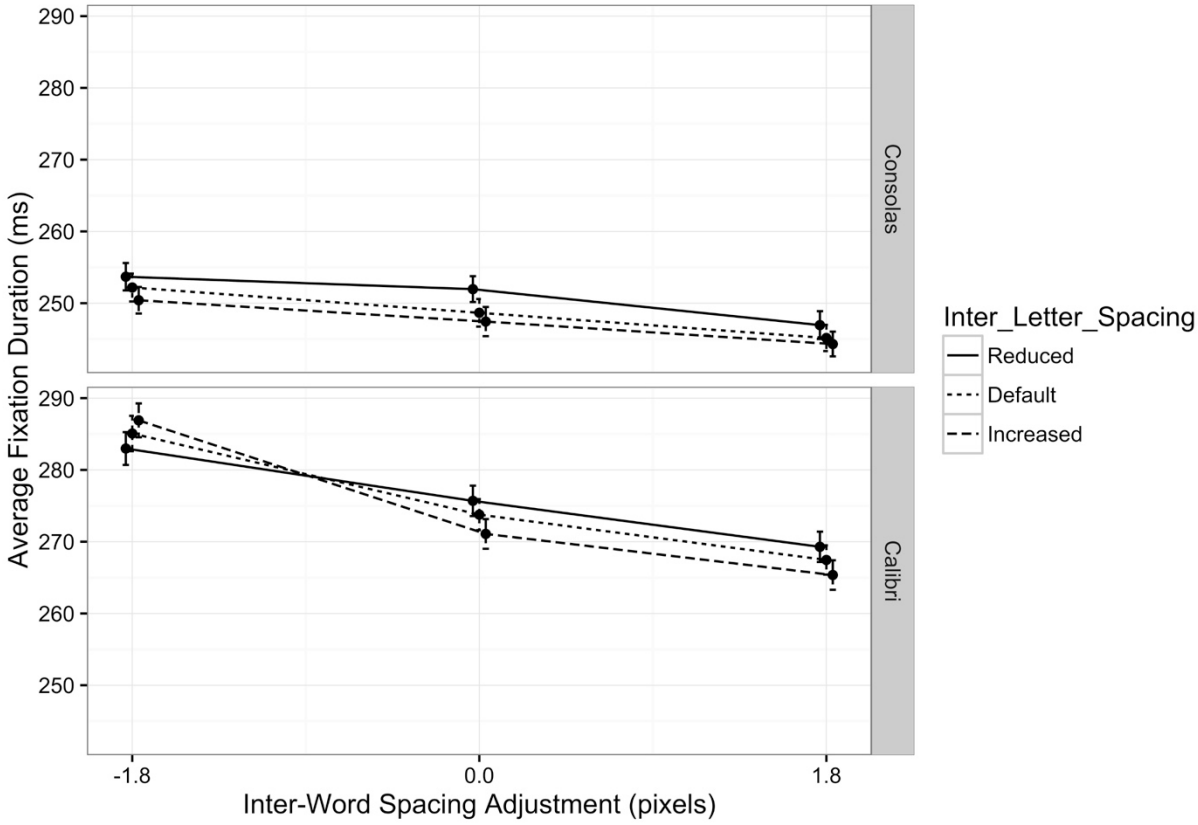
Figure 1S. Number of fixations. Error bars represent within subject confidence intervals (Morey, 2008).



Average Fixation Duration: Average fixation durations were log transformed for analysis. There was a significant main effect of font, b = -9.8 x 10^2, SE = 3.1 x 10^3, t = -31.5, as fixations were shorter when reading Consolas than when reading Calibri. There were significant linear effects of inter-word spacing, b = -3.1 x 10^2, SE = 1.5 x 10^3, t = -20.3, and inter-letter spacing, b = -7.03 x 10^3, SE = 1.4 x 10^3, t = -4.9 as fixation durations decreased with increasing spacing. Font also interacted with both the linear effect of inter-word spacing, b = 2.6 x 10^2, SE = 2.9 x 10^3, t = 9.2, and the quadratic effect of inter-word spacing, b = -9.3 x

10^3, SE = 2.9 x 10^3, t = -3.2. The interaction with the linear effect was due to a steeper slope for inter-word spacing with Calibri than with Consolas (see Figure 2S).

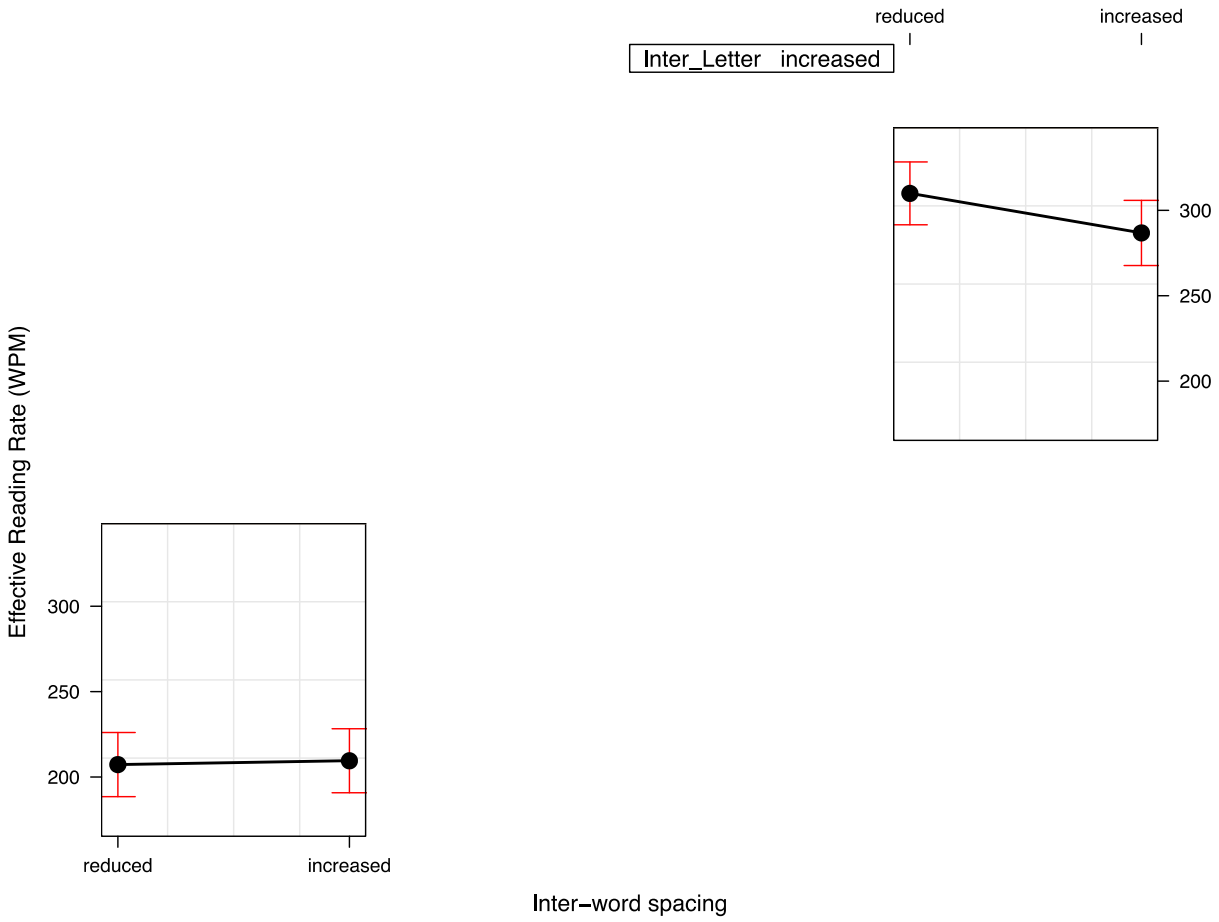
Figure 2S. Average fixation duration. Error bars represent within subject confidence intervals (Morey, 2008).



The interaction with the quadratic effect was the result of inter-word spacing having a larger effect on fixation durations between the reduced and default spacing conditions than between the default and increased spacing conditions for Calibri. Additionally, the linear effect of inter-letter spacing interacted with both components of inter-word spacing, linear b = -6.4 x 10^3, SE 2.5 x 10^3, t = -2.6; quadratic b = 6.6 x 10^3, SE = 2.5 x 10^3, t = 2.7. The interaction between the linear effects was due to the effect of inter-letter spacing growing larger as inter-word spacing decreased. However, this effect was limited to Calibri as evidenced by the significant three-way interaction between these linear effects and font, b = 1.6 x 10^2, SE = 5.0 x 10^3, t = 3.2.

Reading Skill: Prior research has suggested that the benefits of increased spacing are greater for dyslexic readers (Perea et al. 2012; Zorzi et al. 2012). While we did not have any diagnosed dyslexics in our sample, our participants did span a wide range of reading skill as determined by effective reading rate. Therefore, we split our sample into two equal groups with a median split based on participants' effective reading rate for the default inter-word and inter-letter spacing condition. Then this reading skill variable was added to the LMM for effective reading rate along with all the interactions between the other predictors and we fit the model to the remaining, non-default spacing, data. Here we report only the significant interactions with reading skill. There was a significant three-way interaction between reading skill, font, and inter-word spacing, b = -8.15, SE = 1.95, t = -4.18 (see Figure 3S). When considering the high skill readers, we can see the same font by inter-word spacing interaction that we saw in the main analysis. That is, reading performance improved for Calibri as inter-word space was increased but improved for Consolas as inter-word space was decreased. When considering the low skill readers, performance tended to improve (though only slightly) with increasing inter-word space regardless of font. There was also a significant three-way interaction between reading skill, font, and inter-letter spacing, b = -5.76, SE = 1.92, t = -3.00. The main effect of inter-letter spacing on Calibri was modest and negative for both high and low skill readers. However, for Consolas, the benefits of reducing inter-letter spacing was limited to the high skill readers. We also found evidence that font spacing effects differ based on the reading skill of individual participants. However, unlike previous reports, we found that spacing effects were more pronounced for the high skill readers rather than the low skill readers.

Figure 3S. Reading rate by reading skill.

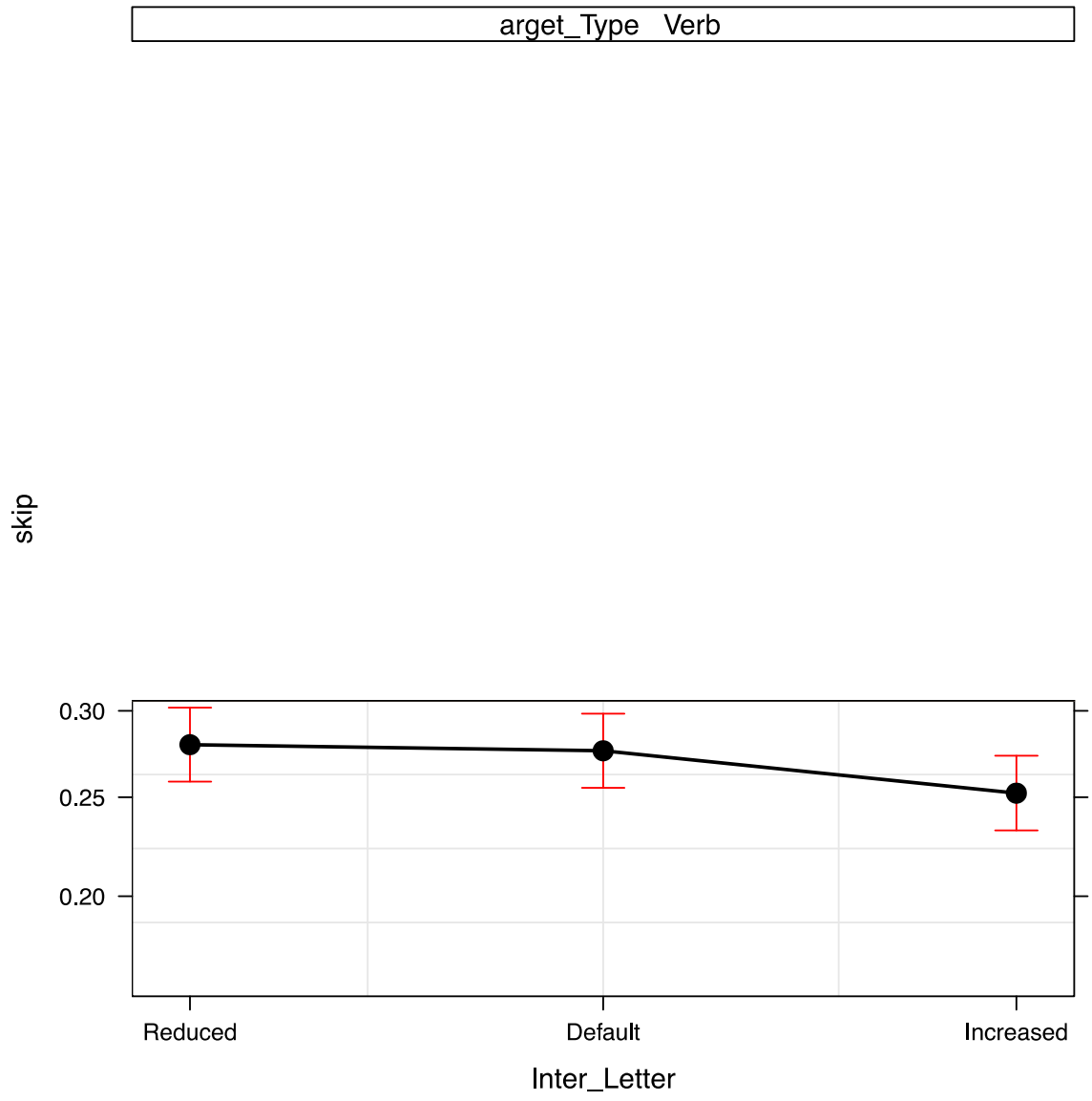


One possible explanation for this unexpected finding is related to the number of different typographical conditions used in the current study. Poor readers are likely to have low quality lexical representations (Perfetti & Hart, 2002) and may have found it difficult to map the large number of different typographical inputs to their internal lexical representations.

Target Word Skipping Rate: First pass reading is defined as the initial pass through a text. It ends for a region of text as soon as the eye moves beyond the region to the right. Since the calculation of gaze duration is contingent on targets being fixated during first pass, it is important to analyze skipping rates in order to have a complete picture of target word processing difficulty. Since skipping represents binomial data we analyzed them with

generalized linear mixed models (GLMMs) using a logit link. In the current experiment, target words were skipped over without fixation during first pass reading 22.6% of the time. Target word skipping rate was higher for function words (27.6%) than for content words (20.0%), b = -.866, SE = .046, z = -18.63, and higher for nouns than for verbs, b = .102, SE = .028, z = -3.54. Skipping rate also declined with increasing inter-letter spacing, b = -.079, SE = .020, z = -4.03 (see Figure 4S).

Figure 4S. Skipping rate effect plot of inter-letter spacing and word type.



Skipping rate was also higher for Calibri than for Consolas, b = -.113, SE = .011, z = -9.97. Note that this effect of font is opposite the one reported for gaze durations which were longer with Calibri than Consolas. Finally, font interacted with inter-word spacing, b = -.057, SE = .020, z = -2.93, as increasing inter-word spacing resulted in higher skipping rates for Calibri but lower skipping rates for Consolas (see Figure 5S).

Figure 5S. Skipping rate effect plot of font and inter-word spacing.