Linguistic focus as predictive attention allocation

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Studies of linguistic focus (roughly, major intonational/informational prominence) routinely find that focused material enjoys a privileged status in sentence comprehension. Comprehenders seem to better remember focused constituents [1], more reliably detect errors in focused positions [2], and are more likely to notice changes to material which had been focused [3]. However, there is little consensus regarding the source of this focus benefit. On the one hand, some studies have found that focused constituents are read more slowly, and re-read more often [4–6], suggesting that focus prompts readers to devote more processing resources to focused material so that it is more thoroughly (if more effortfully) encoded. However, other studies report that focused constituents are read more quickly [7, 8] or allow comprehenders to respond more rapidly [9]. These have been taken to indicate that comprehenders use focus to selectively allocate attention, thereby facilitating processing [10]. While these hypotheses are not inherently incompatible, there remains an empirical tension between the results which motivate them. Does focus facilitate, or arrest processing? Is its effect immediate, or the product of retrospective re-processing? The present study addresses these questions using the boundary paradigm in eye-tracking while reading [11] to test the specific hypotheses that (*i*) comprehenders predictively allocate attention to focused material while it is still in the parafovea, before it is directly fixated, and (*ii*) this increased attention facilitates processing.

Adapting materials from [9], we used question-answer pairs to manipulate whether a critical word was focused ($\pm$*focus*). In $+$*focus* conditions, the critical word constituted a (partial) answer to a wh-question which targeted a position late in the sentence, as in (1b). In $-$*focus* conditions, the question shifted focus to an earlier position in the sentence so that the critical word was not in focus. In addition, we manipulated whether readers had valid parafoveal preview of the critical word ($\pm$*change*). Readers spend less time reading a word with normal (i.e. valid) preview (the "parafoveal preview benefit") [12, i.m.a.]. If focus facilitates processing, and readers are predictively allocating attention to likely focused constituents (i.e. the likely locus of the answer to a wh-question), we expect to find a larger parafoveal preview benefit when the critical word is focused. The example paradigm in (1) shows the two focus conditions together with the display-changed critical word.

(1) a. $-$**Focus:** Which man was wearing a hat?
b. $+$**Focus:** Which hat was the man wearing?
c. **Target:** The man on the corner was wearing the| {ffaw→blue} hat with a wide brim.

48 items patterned on (1) were constructed for an eye-tracking while reading study (n=60). When participants initiated a saccade which crossed a boundary preceding the critical word (indicated here with "|"), a display change occurred which replaced the preview stimulus with the critical target word. In $-$*change* conditions, the preview stimulus was identical to the critical word, while in $+$*change* conditions the preview stimulus was a non-word with similar ascender/descenders to the critical word (e.g. "ffaw").

Figure 1 summarizes reading behavior at the critical word. In duration measures, we found shorter reading times when readers had valid parafoveal preview of the critical word. In addition, we found longer reading times when the critical word was focused than when it was not (for results of statistical modeling, see Table 1). In addition, we found that if parafoveal preview was valid, readers were less likely to regress from (p<.01), and more likely to skip (p<.001) the critical word. Finally, readers were less likely to skip the critical word when it was focused, than when it was not (p<.001).

These findings provide no indication that focus facilitates processing; processing of a focused constituent is actually slower, as in [5, 6]. We also find no interaction of parafoveal preview and focus; the results do not support the hypothesis that a focused word receives additional attention in parafoveal vision. Nevertheless, the fact that readers are less likely to skip focused material suggests that readers are aware of which positions in a sentence are most informative, and modulate their eye movements so as to fixate those positions. In sum, the results confirm that focused words do receive extra attention during processing, while providing no support to the hypothesis that this attention is specifically allocated during parafoveal viewing.

Figure 1: *Mean by-subject reading data (n=60). Error bars represent standard error.*

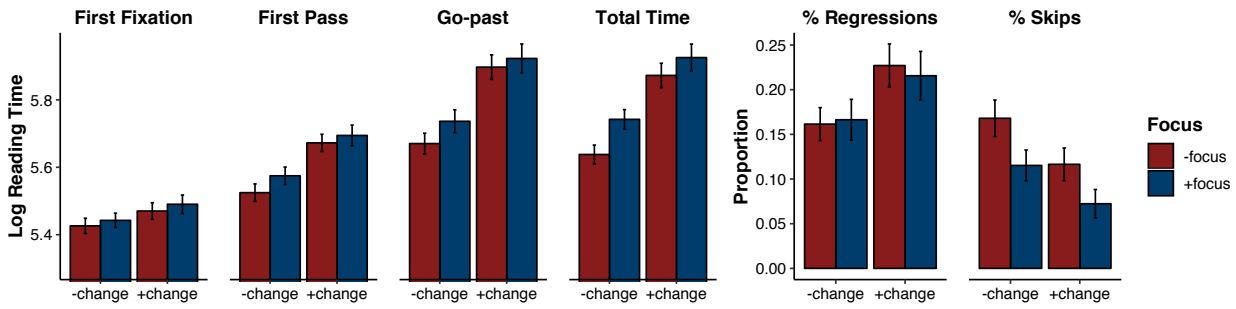

Table 1: *Fixed effect t and z-values for models fit to fixation duration and proportion data. Models consisted of the factors Focus (−focus=−1, +focus=1) and Change (−change=−1, +change=1), and their interaction. Random slopes and intercepts were included for participants and items, excluding correlations between random effects. Cells containing significant coefficients (|t|>2; p<.05) are shaded.*

Fixed Effects	*First Fix.*	*First Pass*	*Go-past*	*Total Time*	*Regressions*	*Skipping*
Focus	1.47	2.11	1.94	3.27	0.35	4.42
Change	3.13	6.12	6.01	6.55	2.82	4.27
Focus×*Change*	0.21	0.52	0.72	1.16	0.30	0.45

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