Eccentric features combine slowly

Alissa Cantone, Katharine Tillman, Denis Pelli
Psychology and Neural Science, New York University

Summary

Reading rate slows more and more as eccentricity increases. This is true even when the words are presented at optimal print size and spacing. Why does eccentricity matter? Reading is object recognition, which is the detection and combination of an object's features to identify the object. Here we measure the "reading" rates for identifying targets: a word (in context), a letter (a-z or x/o), or a grating (out of two orientations), presented at 0, 15, or 30 deg. We then calculate the eccentricity effect (the ratio of foveal and peripheral "reading" rates) for the various targets. For a simple one-feature target (grating or x/o) there is no eccentricity effect. As the complexity of the target increases, the eccentricity effect increases. It takes longer to recognize a complex object in the periphery, apparently because it takes longer to combine the features if we increase their number or eccentricity.

Target	Stimuli	Features	Ecc. effect slope (decade/deg)
Word	garden	35	0.032
a-z	a b c	7	0.013
x/o	x o	1	0.000
Grating	≡ ≡	1	0.003

Table 1 Examples of the four kinds of target, the estimated number of features needed to identify it (Pelli et al., 2006), and the measured eccentricity effect slope.

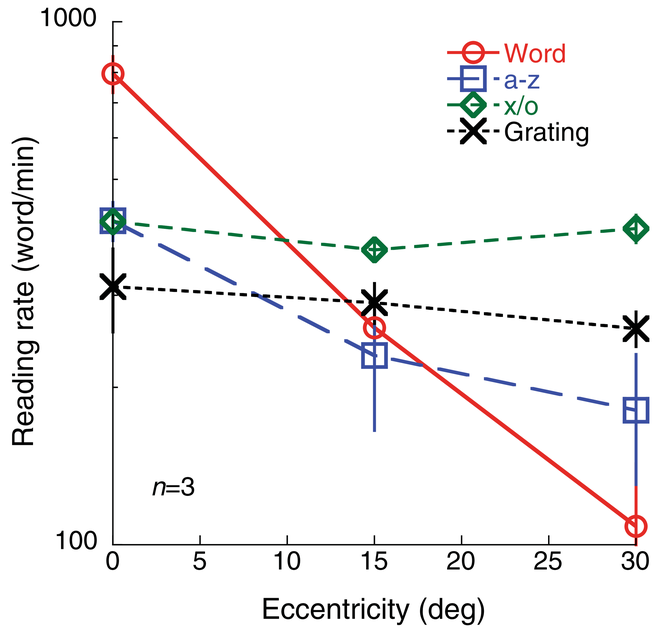


Figure 1 Average result for three observers for the various targets. Note that more complex targets have steeper slopes. We minimize the need for eye movements by using Rapid Serial Visual Presentation (RSVP). A stream of six items is presented at a variable rate and the reader names the items at leisure. The QUEST staircase procedure homes in on the threshold presentation rate for 80% accuracy.

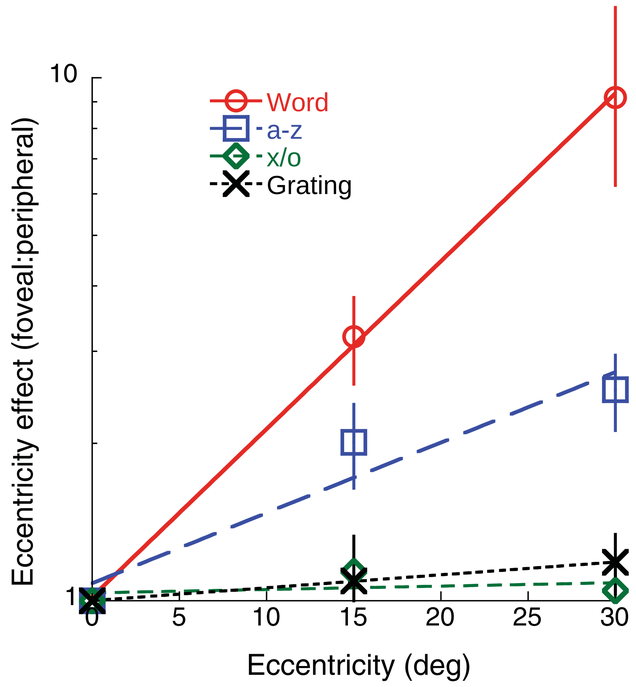
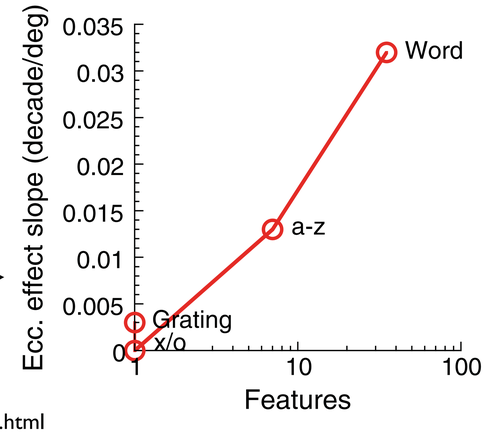


Figure 2 Eccentricity effect: the ratio of foveal to peripheral reading rate. The regression-line slope drops as target complexity is reduced, and hits zero when the target is a single feature.

Figure 3 The eccentricity effect (slope in decade/deg from Fig. 2) as a function of complexity (features).



Cantone, A. R., Tillman, K. A., & Pelli, D. G. (2008), Eccentric features integrate slowly. Vision Sciences Society, Naples, Florida, May 9-14, 2008. http://psych.nyu.edu/pelli/posters.html