Fixation Density Disparity (FDD) is designed to objectively measure the fluency of the initial reading of a relatively long critical region (e.g. a sentence) in reading experiments using eye-tracking.

During initial reading of a region, **FDD** = 
$$\begin{cases} 0 & \text{(if } f = 0\text{),} \\ \dfrac{F}{f} & \text{(if } f > 0\text{)} \end{cases}$$
where
$F$ = the number of *surrounding* fixations
$f$ = the number of *surrounded* fixations

A given fixation is characterised as a s*urrounded* fixation when there are other fixations within the vicinity of 5 characters to the left or right of that fixation (blue circled fixation in Example 1 below). These neighbouring fixations are *surrounding* fixations (fixations indicated by purple arrows in Example 1). The window of 5 characters to the left and right of a given fixation is motivated by a commonly reported average saccade size of 5-7 characters between fixations during normal reading (e.g., Morrison & Rayner, 1981).

A high FDD value indicates that there are clusters of spatially densely distributed fixations during initial reading of the critical region (e.g., due to frequent re-inspections of words), suggesting faltering reading (Example 1).  By contrast, a low FDD value occurs when fixations are evenly distributed across the critical region, indicating reasonably fluent reading; an FDD of 0 suggests perfectly fluent reading (Example 2).

> *Note.*  A cut-off FDD value of 2 (see outlier definition in paper) implies that the average first pass fixation per region may be surrounded by no more than two fixations within its 5-character vicinity.

**Example 1**:  Faltering reading (each green square represents a fixation; the lines between them represent saccades; each grey column represents a character position)
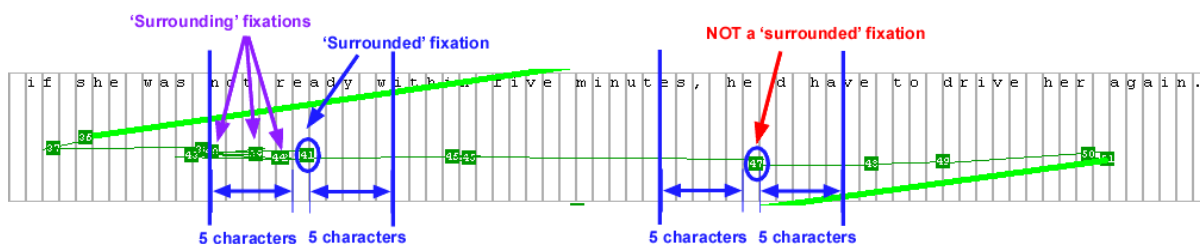


| Fixation ID | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | total | FDD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Number of surrounding* fixations at each given fixation | 1 | 1 | 3 | 6 | 5 | 3 | 4 | 3 | 4 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | $F$ =36 | 2.4 |
| *Surrounded* by other fixations? (0=no, 1=yes) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | $f$ = 15 | |

**Example 2**:  Fluent reading.
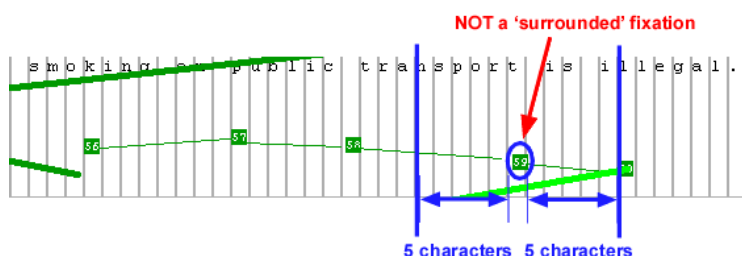


| Fixation ID | 1 | 2 | 3 | 4 | 5 | total | FDD |
|---|---|---|---|---|---|---|---|
| *Number of surrounding* fixations at each given fixation | 0 | 0 | 0 | 0 | 0 | $F$ = 0 | 0 |
| *Surrounded* by other fixations? (0=no, 1=yes) | 0 | 0 | 0 | 0 | 0 | $f$ = 0 | |

**Reference**

Morrison, R. E., & Rayner, K. (1981). Saccade size in reading depends upon character spaces and not visual angle. *Perception and Psychophysics*, *30(4)*, 395-396.