

# Eye Movements as Implicit Relevance Feedback

Georg Buscher, Andreas Dengel, Ludger van Elst, Florian Mittag  
 University of Kaiserslautern  
 and DFKI  
 Kaiserslautern, Germany  
 {firstname.lastname}@dfki.de

## Question

Can personal relevance of a text be inferred from eye movements?

## Approach

- Detect text parts that have been read or skimmed by the user
- Calculate eye movement measures only for viewed text parts
- Correlate eye movement measures with explicit relevance ratings

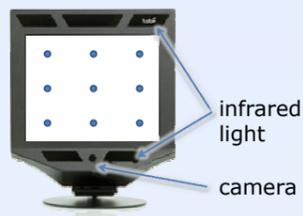
## Conclusion

- Reading and skimming differentiation is very useful for predicting relevance.
- The appropriate eye movement measure is quite expressive.

## Reading/Skimming Detection

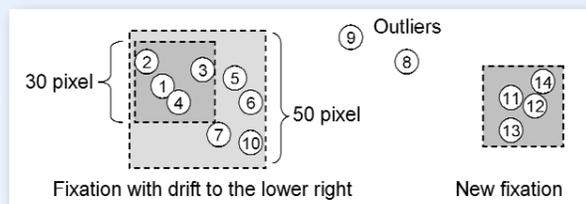
### Material

- Eye tracker (Tobii)
  - Desk-mounted, unobtrusive
  - 50 Hz data generation frequency for both left and right eye
  - 9-point calibration method



Detection and differentiation between reading and skimming behavior in 3 steps:

### 1. Fixation Detection



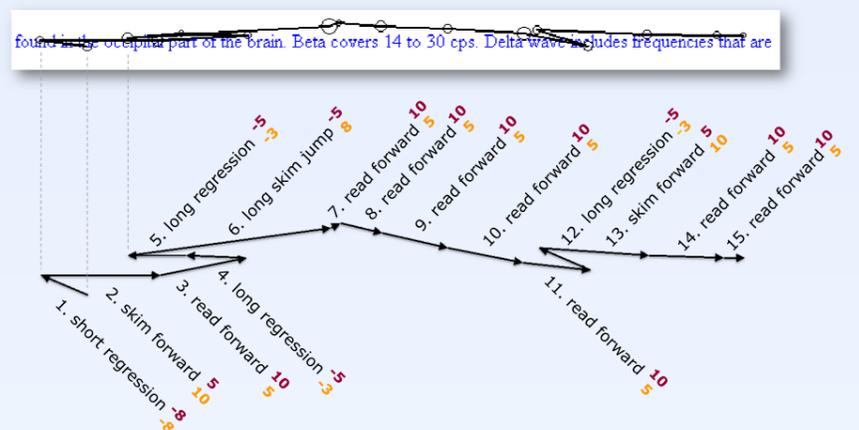
Nearby gaze locations are aggregated.  
 Outliers can be ignored.

### Example



### 3. Reading and Skimming Detection

Feature scores associated with the  
 - reading detector  $r$  and the  
 - skimming detector  $s$   
 are accumulated:



Reading detector score

$$S_r = -8 + 10 + 10 - 5 - 5 + 10 + 10 + 10 + 10 + 10 - 5 + 10 + 10 = 62$$

Skimming detector score

$$S_s = -8 + 10 + 5 + 3 - 3 + 8 + 5 + 5 + 5 + 5 - 3 + 10 + 5 + 5 = 51$$

Reading behavior detected

### User Observation - Example

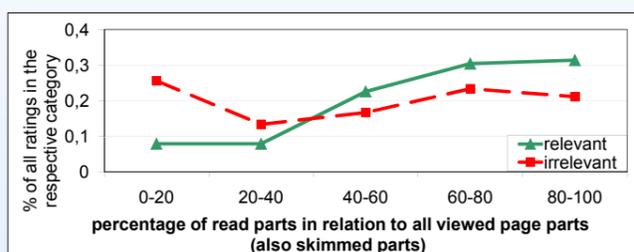
### 2. Classification of Fixation Transitions

Distance and direction in letter spaces	Feature	Reading detector score $s_r$	Skimming detector score $s_s$
$0 < x \leq 11$	Read forward	10	5
$11 < x \leq 21$	Skim forward	5	10
$21 < x \leq 30$	Long skim jump	-5	8
$-6 \leq x < 0$	Short regression	-8	-8
$-16 \leq x < -6$	Long regression	-5	-3
$x < -16$ and $y$ according to line spacing	Reset jump	5 and line delimiter	5 and line delimiter
All other movements	Unrelated move	Line delimiter	

Every jump from one fixation to the next is classified as one of the above features.

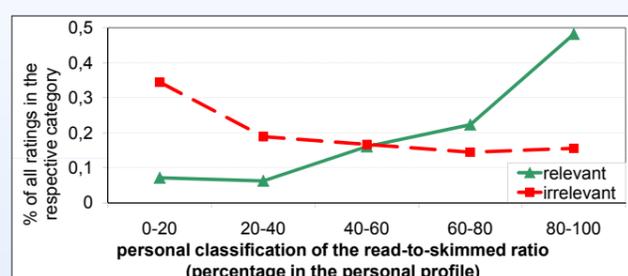
## An Eye Movement Measure for Relevance Prediction: $\frac{\text{Length of Read Text}}{\text{Length of Skimmed Text}}$

- Case study with 19 participants and 16 texts to read
- Relevance ratings for each text
- Eye movements were recorded



➤ Read-to-skimmed ratio indicates relevance

Personalization of the measure by considering the participants' individual profiles (i.e., minimum and maximum values).



➤ Personalization of measuring increases discriminative power