

# The relationship between visual functions and reading performance in children with reading difficulties

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purpose

Learning to read is a milestone during primary school, the foundation for lifelong learning and participation in society (OECD 2010). From a visual perspective reading is a very complex task and requires the effortless and rapid processing of fine visual details (Hyvärinen 2014, Trauzettel-Klosinski 2002). This study aims to explore how children with reading difficulties face reading demands and to assess their visual skills associated with reading.

design

This qualitative study is conducted using a multi-method approach involving assessment, observation and an oral interview. The participants were 3rd to 5th graders with sustained reading difficulties from 24 primary schools in Dortmund, Germany. The design of the study focuses on three components: environmental factors, visual functions and reading performance and analyses their impact, relationship and interaction.

### Environmental factors:

Survey of beneficial and hindering environmental factors through a semi-structured oral interview.

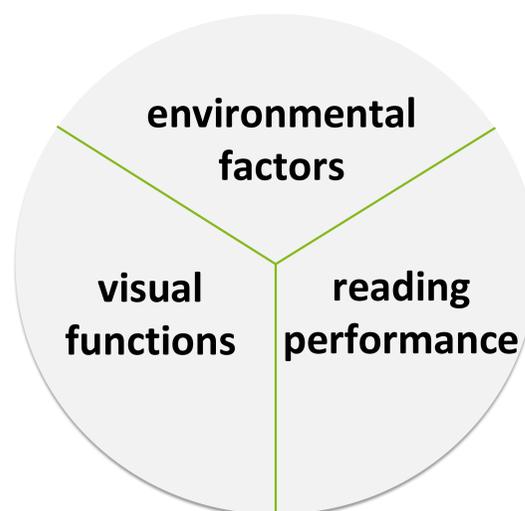
### Visual functions:

#### Oculomotor functions:

- eye alignment
- motility / smooth pursuit
- fixation / saccades / scanning
- accommodation / vergence
- fusion

#### Sensory functions:

- VA near single / line / crowded optotypes
- VA distance
- contrast sensitivity
- grating acuity
- line length / line direction / angles



### Reading performance:

Reading comprehension is assessed through ELFE 1-6, a standardized reading test for children from 1st to 6th grade under varying layout conditions.

- text size
- line spacing
- letter spacing
- contrast

Performed on the eye-tracker (Tobii TX300)

case examples

### Lisa\* (10yr)

#### Visual functions (selected):

- smooth pursuit: temporarily loss of fixation
- **scanning: severe difficulties**
- VA near single 1.00
- VA near line 0.50
- **VA near crowded 0.32**
- VA distance 0.63
- **VA low contrast 0.16**
- **grating acuity 2 cpd**
- **central visual field 5-7°**



#### Environmental factors: self-report

- **light / background**
  - “The brighter it is, the better I can see and the better I can read.”
- **orientation / line spacing**
  - “Sometimes I get confused and I don’t know which line I am in. Then I put something underneath the line.”



#### Reading performance:

Lisa showed severe reading difficulties with small and low contrast print. She often lost track of her position within the line; she used her finger to guide herself.

### Dominik\* (10yr)

#### Visual functions (selected):

- saccades: slightly hypometric to the right
- VA near single 1.40
- VA near line 1.25
- **VA near crowded 0.63**
- VA distance 1.00
- **VA low contrast 0.40**
- grating acuity 42 cpd



#### Environmental factors: self-report

- **letter size**
  - “Before I choose a book, I look inside to see, how small the print is. The bigger, the better.”
  - “In the library I choose the books for the second grade, because the letters are bigger.”
  - “When I have to read small print, I need breaks because I get a headache.”
- **contrast**
  - inverted contrast preferred

#### Reading performance:

Dominik read most words letter-by-letter with many intra-word-fixations. He showed a more precise and efficient word-recognition when letter-spacing was increased.

conclusion

The collected data (study still in progress) points to “VA crowded“, “grating acuity“ and “contrast sensitivity“ as significant functions in reading difficulties suggesting that these reading related functions need attention and analysis to better understand the children’s basic conditions for reading.

The data from children’s self-reports about their own reading preferences demonstrates that children, in most cases, know exactly what conditions they require to handle reading tasks. Their knowledge about beneficial conditions should be considered when establishing appropriate learning materials and aids for them.