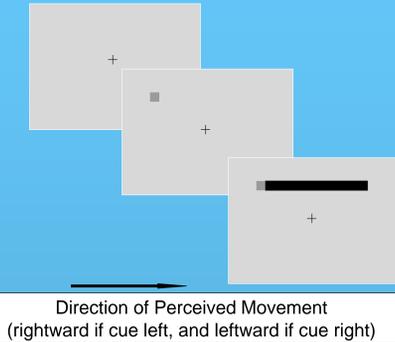


# What Visual Attention Can and Cannot Tell Us About Reading Acquisition in Children

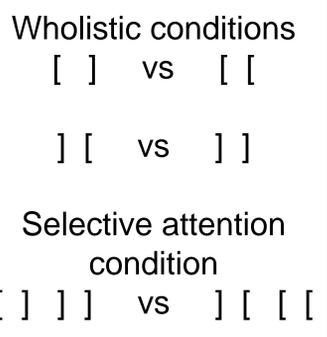
Richard Kruk

Reading ability, visual motion detection sensitivity, backward masking, visual attention, and phonological skills were examined in a cross-sectional sample of children from Kindergarten to Grade 3. Although evidence of developmental change was found in reading, visual, and phonological measures, none of the visual sensory and attentional measures were found to uniquely predict basic reading ability once phonological and rapid naming abilities were controlled. The results support a model of visual involvement in reading achievement for wholistic visual attention, global motion detection, and rate of visual processing mediated primarily by orthographic and phonological processes. Visual attention capture, as measured by the Line Motion Illusion task, was not related to reading achievement, despite expectations, and demonstrates a limit to the utility of one aspect of visual attention.

**Line Motion Illusion**  
Percent reports of illusory line movement away from cue presented in visual periphery

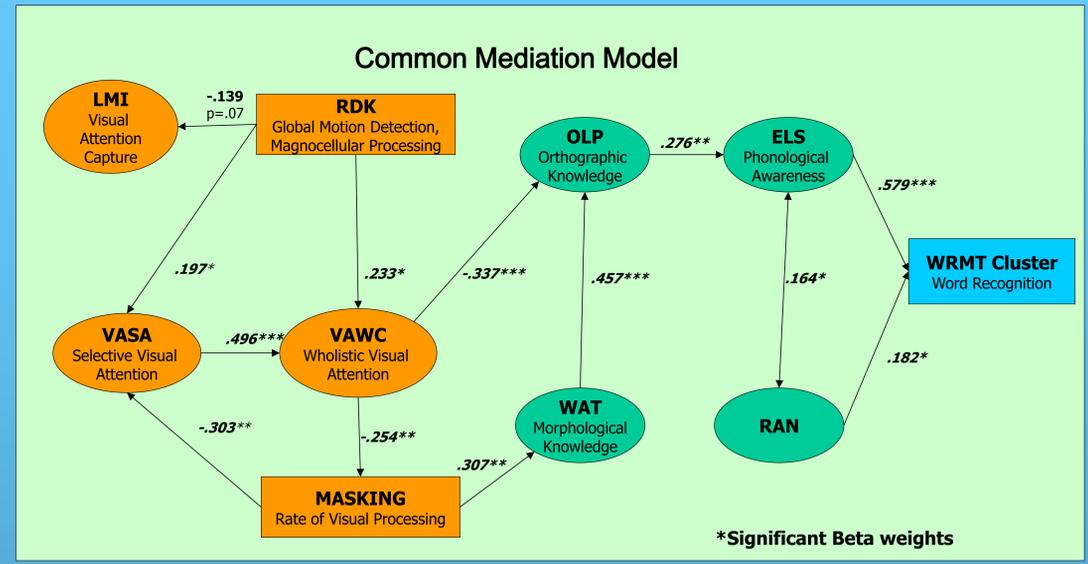


**Visual Attention Card Sort**  
Mean time to sort 32 cards in each condition  
Each condition repeated once



**OLP:**  
Orthographic Letter Pairs Task  
Measure of Orthographic Knowledge using word-likeness judgments of nonword letter pairs (e.g., *fant* – *tanf*)  
Children made judgments on 16 pairs

**WAT:**  
Word Analysis Test  
Measure of Morphological Knowledge using single- and double-morpheme words  
Children asked to judge whether there was a smaller word in each item that had a similar meaning (e.g., “teacher” – yes; “corner” – no)  
Children made 18 judgments



## Hypotheses

1. Developmental trends:  
**Visual Attention:** Higher likelihood of perceiving **Line Motion Illusion** (showing efficient attention capture) and faster **Visual Attention Card Sort** (more efficient wholistic and selective attention) in older children. Both predict reading achievement (1, 2).
2. **Visual Sensory Processes:** **Global motion detection** (reflecting magnocellular processes), **backward masking** (reflecting rate of visual processing) will improve with age. Both will predict reading achievement (3, 4).
3. A common mediation model for visual attention and sensory processes via orthographic knowledge (3).

## Developmental Trends

175 Children from Kindergarten to Grade 3, sampled from Winnipeg public schools. Typically-developing and struggling readers included in sample.

|                  | Grade -- M (SE)     |               |                |                   |
|------------------|---------------------|---------------|----------------|-------------------|
|                  | Kindergarten (N=32) | Grade 1(N=40) | Grade 2 (N=58) | Grade 3 (N=45)    |
| N Male/Female    | 17 / 15             | 21 / 19       | 32 / 26        | 22 / 23           |
| Age(months)      | 70.50 (0.83)        | 82.85 (0.74)  | 96.05 (0.62)   | 106.07 (0.70) *** |
| Vocabulary (1)   | 9.75 (0.59)         | 8.66 (0.54)   | 8.97 (0.44)    | 9.16 (0.50)       |
| WRMT-WI (2)      | 6.91 (2.44)         | 33.13 (2.18)  | 50.95 (1.81)   | 61.00 (2.06) ***  |
| Basic Skills (2) | 100.09 (3.28)       | 109.90 (2.19) | 105.86 (1.82)  | 106.82 (2.06) *   |
| CTOPP-ELS (3)    | 9.48 (0.54)         | 10.33 (0.46)  | 10.24 (0.38)   | 10.22 (0.43)      |
| CTOPP-RAN (3)    | 9.47 (0.39)         | 9.04 (0.35)   | 9.27 (0.29)    | 8.81 (0.33)       |
| OLP (4)          | 55.50 (2.89)        | 61.18 (2.09)  | 76.34 (1.72)   | 83.78 (1.92) ***  |
| WAT (5)          | 44.44 (4.59)        | 53.95 (4.14)  | 70.24 (3.41)   | 76.91 (3.81) ***  |
| LMI (6)          | 0.65 (0.05)         | 0.63 (0.05)   | 0.70 (0.04)    | 0.71 (0.04)       |
| Card – WC (7)    | 77.44 (4.07)        | 49.14 (3.64)  | 43.11 (3.03)   | 39.54 (3.22) ***  |
| Card – SC (7)    | 91.05 (5.26)        | 67.22 (4.80)  | 61.90 (3.92)   | 57.19 (4.16) ***  |
| Masking (8)      | 0.58 (0.02)         | 0.58 (0.01)   | 0.62 (0.01)    | 0.64 (0.01) ***   |
| RDK (8)          | 76.40 (4.47)        | 66.74 (3.87)  | 68.92 (3.27)   | 60.24 (3.65) *    |

\*p<.05, \*\*p<.01, \*\*\*p<.001  
 (1) WISC-III/WPPSI-R Vocabulary standard score (M=10, SD=3)  
 (2) Woodcock Johnson Reading Mastery Test-Revised: Word Identification raw score; Basic Skills Cluster standard score (M=100;SD=15)  
 (3) Comprehensive Test of Phonological Processing Elision, Composite Rapid Naming standard score (M=10, SD=3)  
 (4) Orthographic Letter Pair Task, percent correct accuracy  
 (5) Word Analysis Test, percent correct accuracy  
 (6) Line Motion Illusion: Proportion of trials of reported illusory line movement in direction away from cue  
 (7) Visual attention card sort: WC (wholistic) SA (selective attention) conditions (Card sort time in seconds)  
 (8) Backward Masking: Proportion same/different judgment accuracy  
 (9) Random Dot Kinematogram (global motion detection - measure of magnocellular processes)  
 (Percent dot coherence at 75% threshold accuracy for up/down motion detection: lower scores reflect stronger magnocellular processing)

## Correlations with Basic Skills Cluster

| Measure   | r        |
|-----------|----------|
| CTOPP ELS | .670 *** |
| CTOPP RAN | .401 *** |
| OLP       | .308 *** |
| WAT       | .256 **  |
| LMIC      | .006     |
| VAWC      | -.223 *  |
| VASA      | -.088    |
| Masking   | .167 *   |
| RDK       | -.232 ** |

## Conclusions

1. **Visual Attention:** Only card sort performance improves as children mature. Improvement on both **sensory measures** also observed.
2. Wholistic visual attention and visual sensory measures were significantly related to reading.
3. Influence of wholistic visual attention and visual sensory measures supports a common mediation model.

## What Visual Attention Can Tell Us

Wholistic visual attention predicts word recognition through its involvement with orthographic, morphological and phonological ability.  
 Motion detection involvement is mediated by wholistic attention.  
 Rate of visual processing is predicted by wholistic attention, and rate of visual processing in turn predicts morphological knowledge.

## What Visual Attention Cannot Tell Us

Visual attention capture (as measured by LMI) cannot predict word recognition achievement.  
 Lack of relationship between visual attention measures and rapid naming indicates a limit to the utility of visual attention measures as predictors of reading achievement.

(1) Hari et al. (2001). *Brain*, 124, 1373-1380.  
 (2) Solman et al. (1991). *Ophthalmic and Physiological Optics*, 11, 320-327.  
 (3) Cornelissen et al (1998) *Vision Research*, 16, 185-191.  
 (4) Kruk et al. (2001). *Cognitive Neuropsychology*, 18, 19-37.

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