

Left Minineglect and the Magnocellular Deficit Theory in Children with Reading Difficulties

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We examined how visual information in the periphery of the left and right visual fields facilitates or inhibits allocation of visual attention during a line motion illusion (LMI) task. Contrast-defined and isoluminant color-defined versions of the LMI task were used to examine magnocellular visual system involvement.

A developmental trend in ability to perceive both contrast- and isoluminant-defined LMI was found: Kindergarten children had difficulty perceiving the illusion, whereas older children readily experienced the effect, particularly at longer cue-line delays. No evidence of left mini-neglect was found in struggling readers. A gap between cue and line had a detrimental effect on ability to perceive the illusion for all groups in both LMI tasks.

This result provides qualified support for a visual attention spotlight explanation of the LMI. Similar performance on both LMI task versions was not consistent with expectations based on magnocellular visual involvement in the illusion. Significant correlations between RDK and LMI tasks in unselected but not selected samples provide only qualified support for the magnocellular deficit theory.

Line Motion Illusion (LMI)

Static line presentation perceived as growing away from attentional cue in the visual periphery

Left Mini-Neglect

Individuals with reading disability tend to perceive LMI less often than average readers when cue is on the left side; they perceive LMI more often than average readers when cue is on the right (1). Visual attention deficit in right hemisphere?

Magnocellular Deficit Theory

Anomalous magnocellular visual channel (motion detection, large global visual forms, fast acting) in children with reading difficulty. Correlated with reading performance, possible visual attentional mediation.

Could left mini-neglect be related to the Magnocellular Deficit as a mediator to poor reading performance?

Hypotheses

1. Developmental trend: Illusion perceived more readily (efficient attention capture) as children mature
2. Left mini-neglect in poor readers: more leftward responses in contrast-defined task (magnocellular); correlation with RDK performance
3. Spotlight of attention: gap reduces ability to perceive LMI for all; inhibitory surround reduces speed of visual processing

Method

Unselected Sample: 182 K to Gr. 3 Below Average and Average readers

Selected Sample: 39 children from Unselected Sample - Struggling- and Control-Readers, matched on age, sex, vocabulary

Reader Groups -- M (SE)

	Unselected Sample		Selected Sample	
	Below Average (N=56)	Average (N=126)	Struggling Readers (N=20)	Control Readers (N=19)
Male/Female	30 / 26	61 / 65	11 / 9	9 / 10
Age(months)	89.25 (2.07)	89.03 (1.24) ns	83.30 (3.79)	84.79 (3.27) ns
Vocabulary (1)	8.13 (0.47)	9.70 (0.28) **	6.50 (0.99)	8.00 (0.76) ns
WRMT-WI (2)	91.14 (0.98)	112.26 (0.82) ***	82.75 (1.14)	109.84 (2.88) ***
CTOPP-ELS (3)	8.21 (0.31)	10.99 (0.24) ***	6.90 (0.52)	9.26 (0.51) **
RDK (4)	77.07 (3.10)	64.10 (2.21) ***	79.59 (4.58)	69.33 (5.94) ns

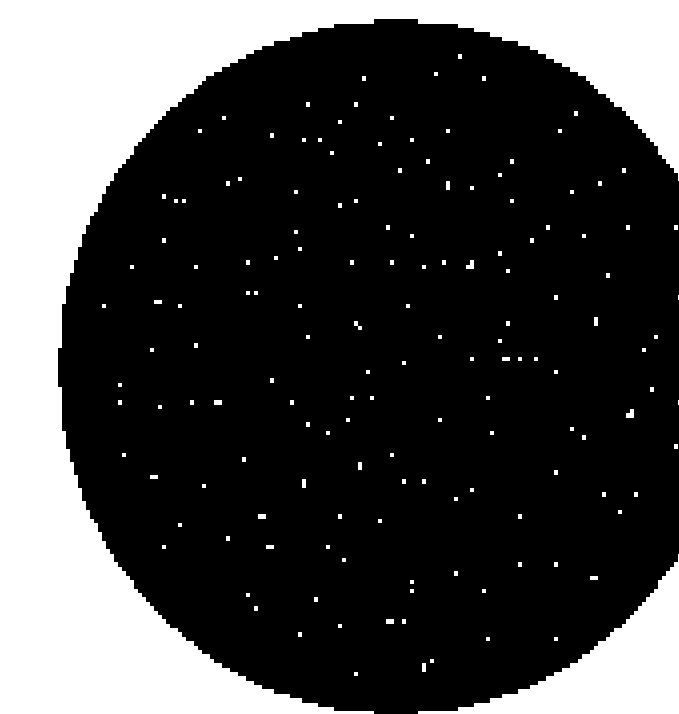
*p<.05, **p<.01, ***p<.001

(1) WISC-III/WPPSI-R Vocabulary standard score (M=10, SD=3)

(2) Woodcock Johnson Reading Mastery Test-Revised, Word Identification standard score (M=100, SD=15)

(3) Comprehensive Test of Phonological Processing Elision standard score (M=10, SD=3)

(4) Random Dot Kinematogram (global motion detection - measure of magnocellular processes) (Percent dot coherence at 75% threshold accuracy for up/down motion detection)



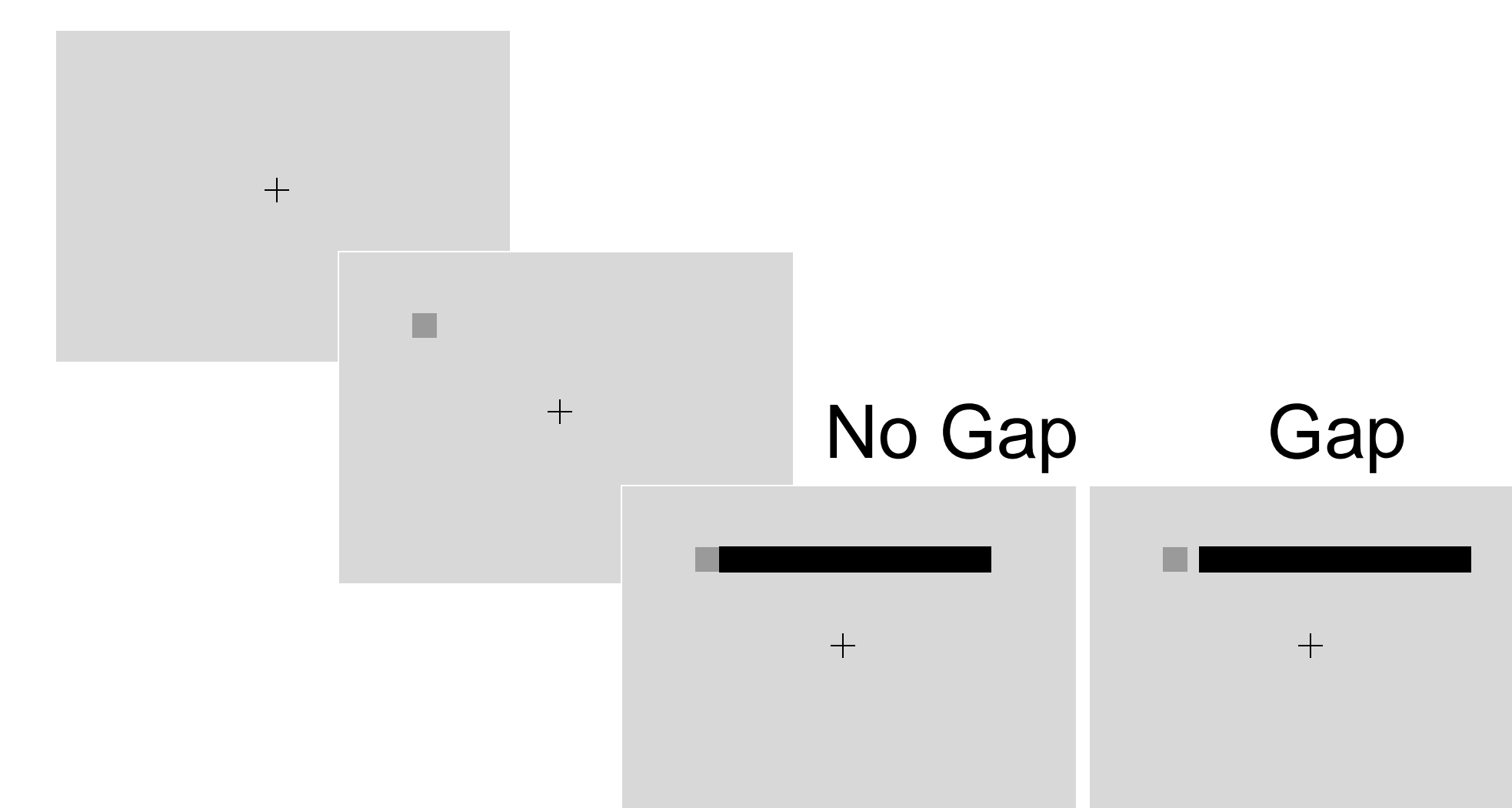
Line Motion Illusion

Percent leftward line movement

Varied: cue-line delay, cue location, gap

Contrast-Defined:

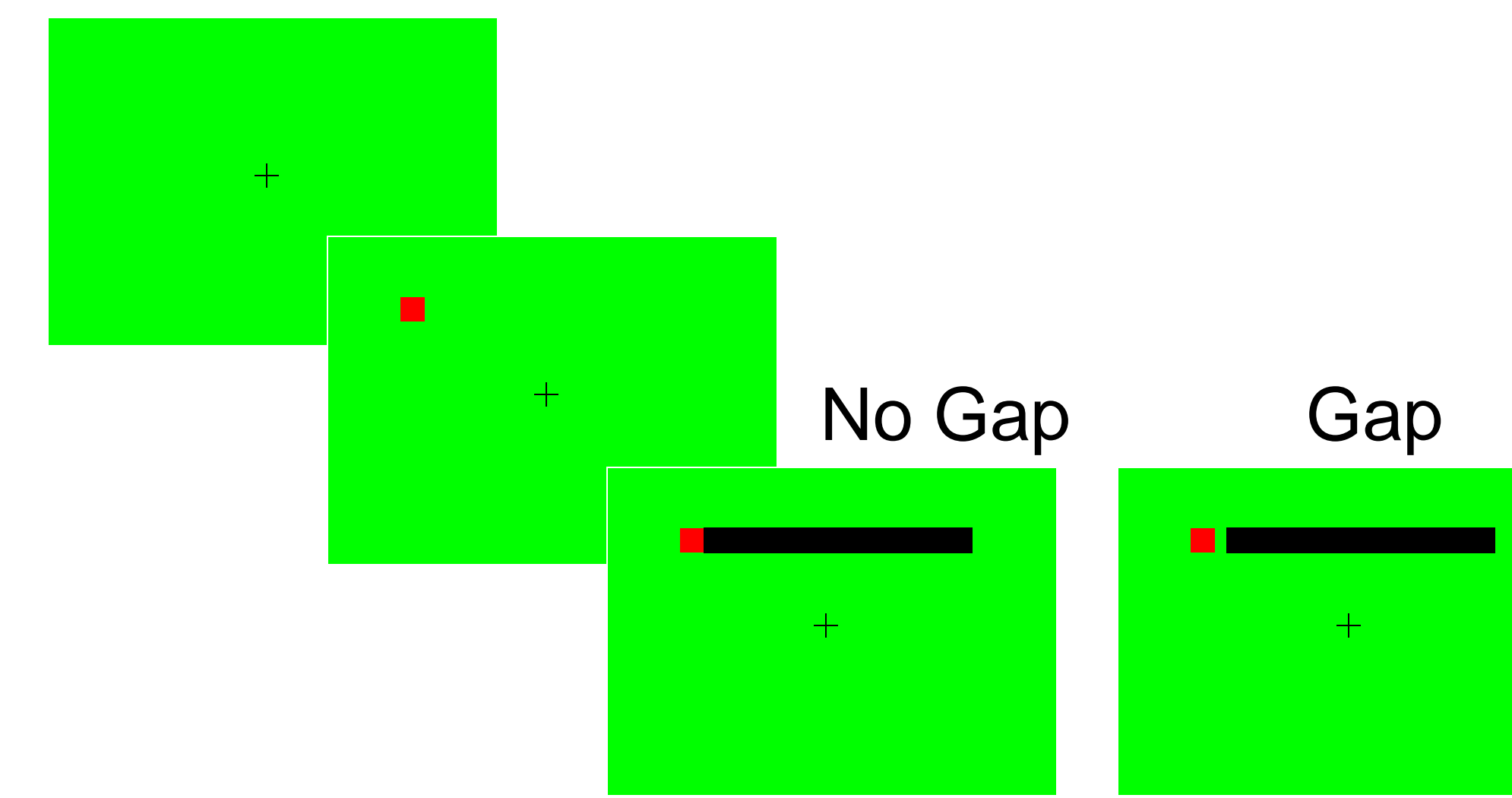
Stimuli different luminance



Direction of Perceived Movement

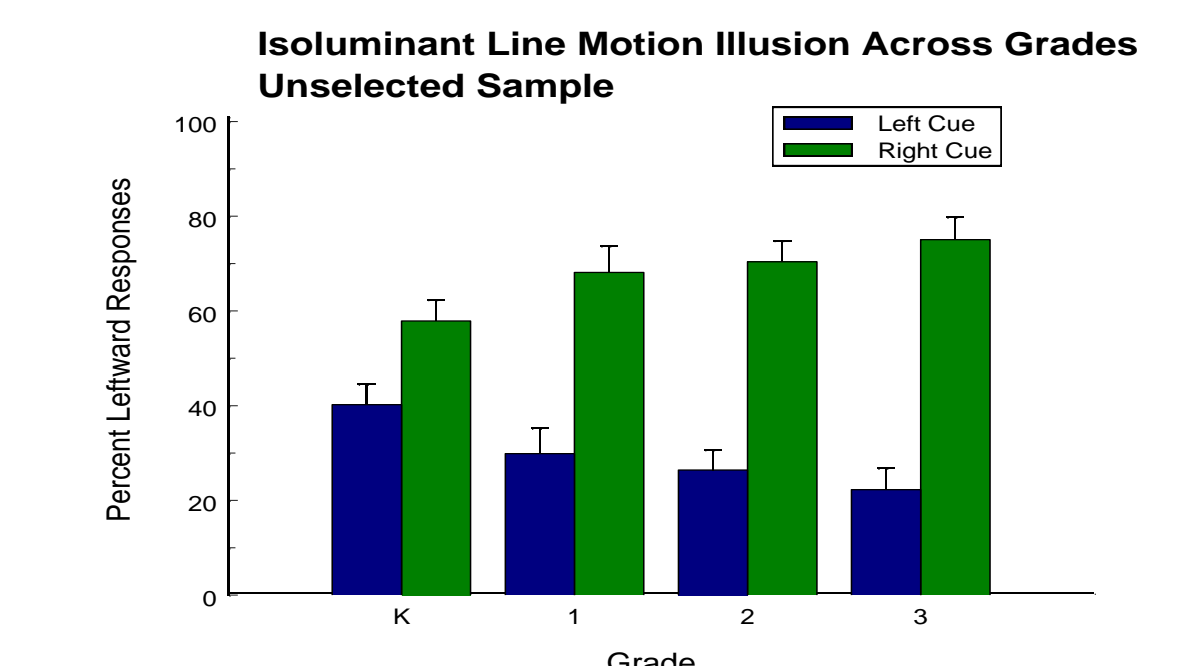
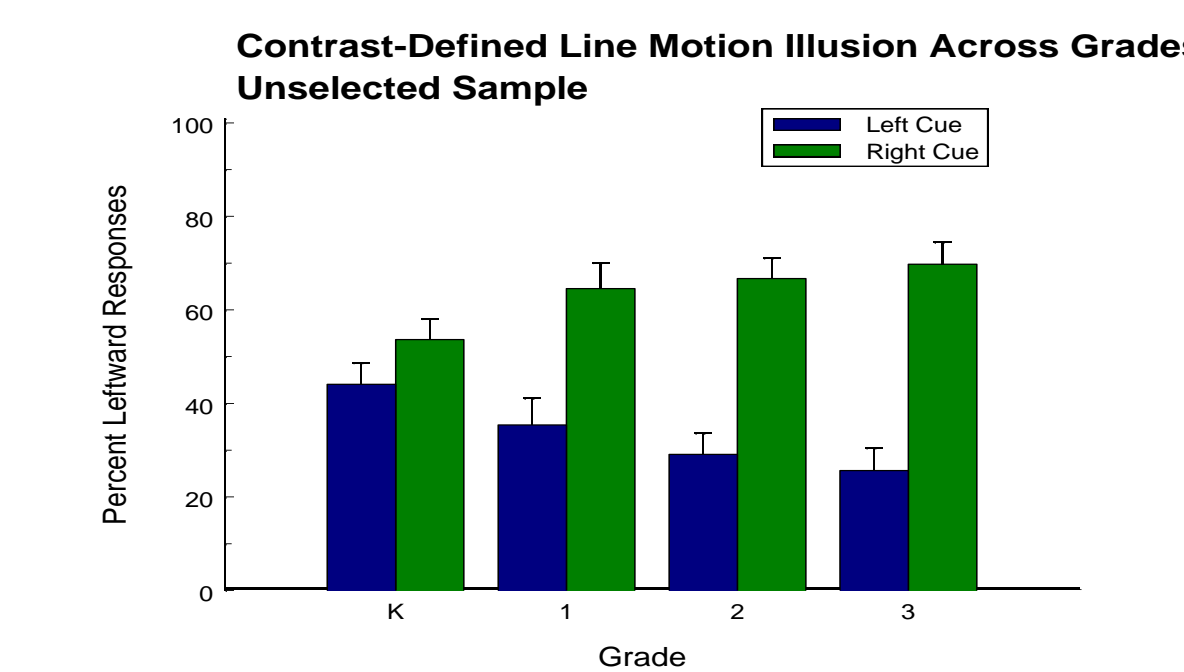
Isoluminant:

Color stimuli equal luminance



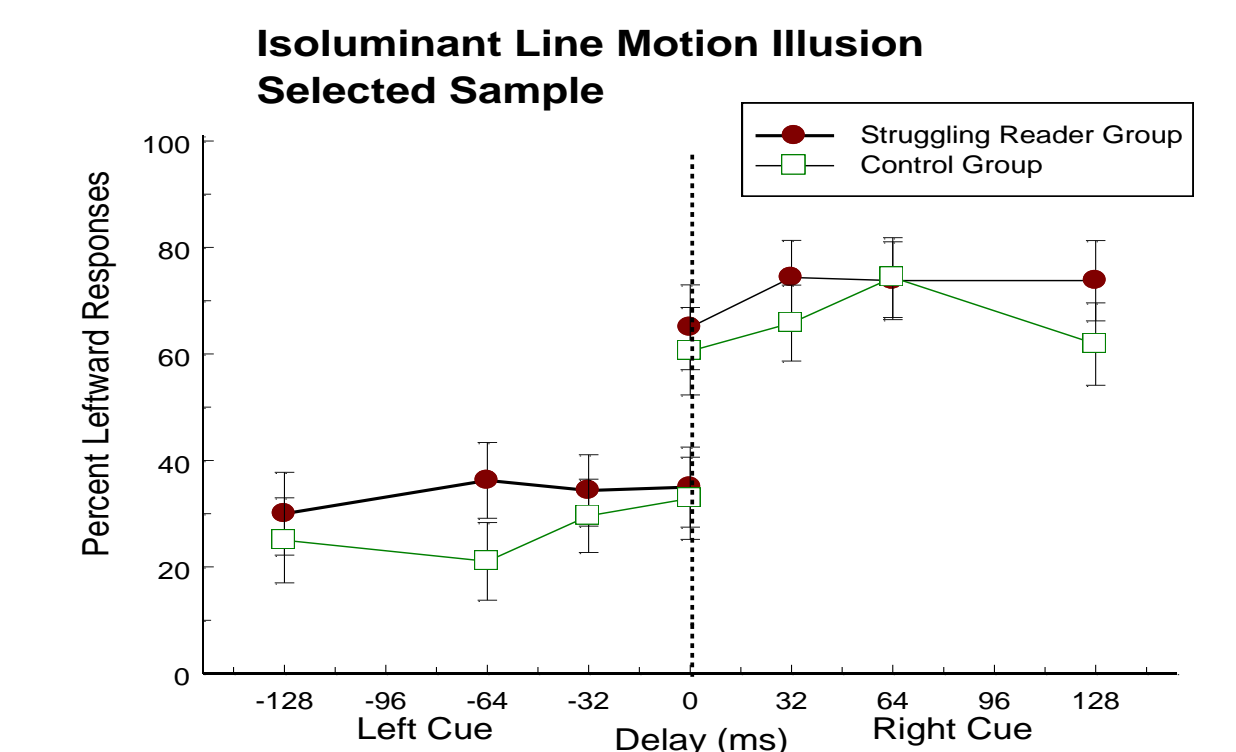
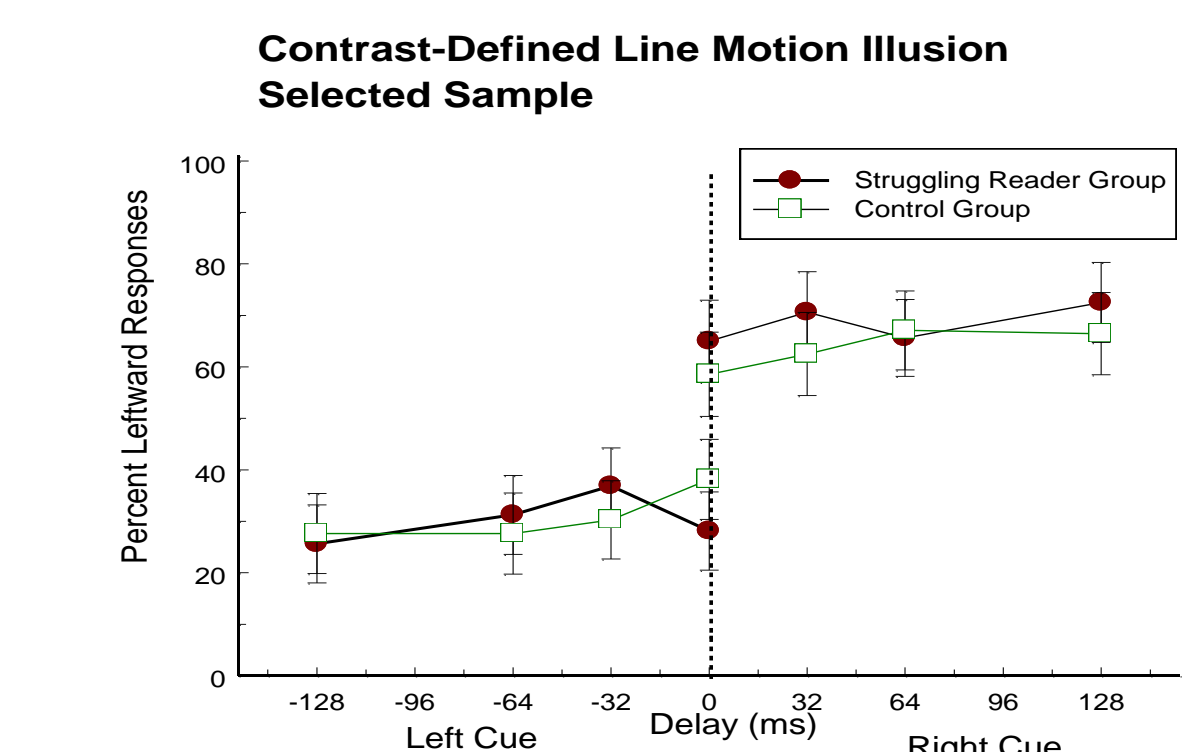
Direction of Perceived Movement

Unselected Sample



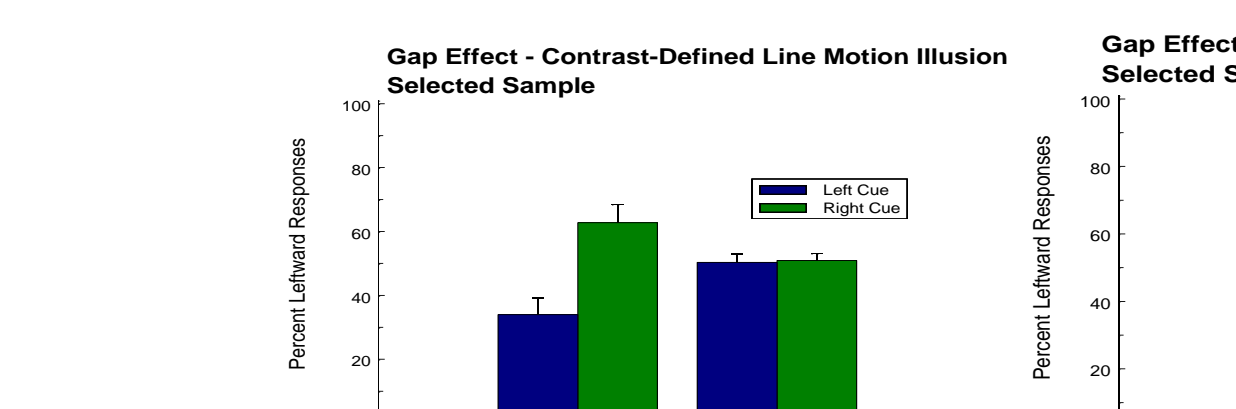
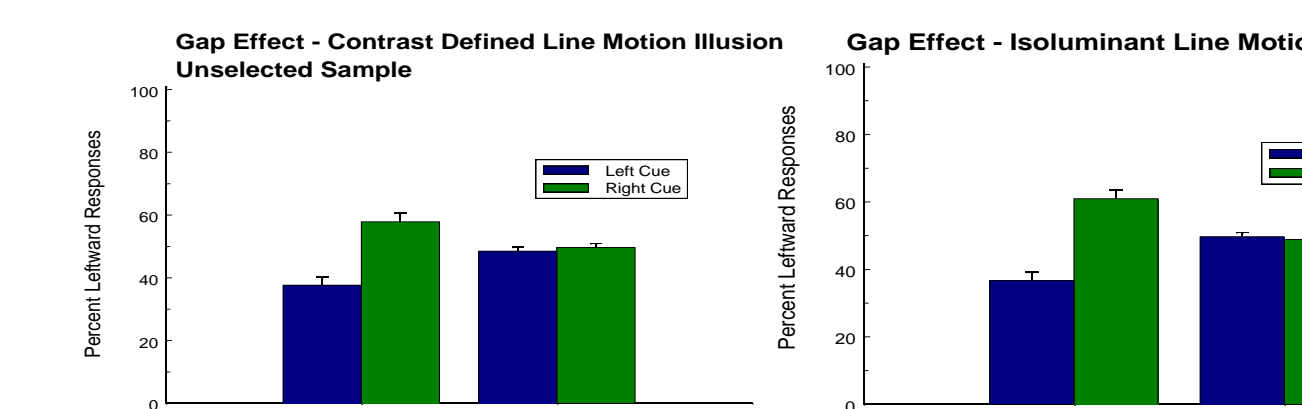
Cue location X Grade effects indicate developmental trend in ability to perceive LMI

Selected Sample



Delay X Reader group effects indicate that Struggling Readers have more difficulty perceiving the illusion than Control Readers

Gap Effect



Cue X Gap effects indicate presence of a spatial gap between cue and line diminishes the ability to perceive the LMI among all age and reading ability groups.

Correlations with RDK

Unselected: LMI-C Left Cue r = .178, p=.016

Right Cue r = -.193, p=.009

LMI-I Left Cue r = .158, p=.033

Right Cue r = -.182, p=.014

Selected: ns

Despite similarity of results between contrast-defined (preferentially activating magnocellular processes) and isoluminant (not preferentially activating magnocellular processes), significant correlations with RDK performance indicates magnocellular involvement in both LMI tasks, but only in the unselected sample.

Conclusions

1. Developmental trend: ability to perceive LMI emerges with age
2. No evidence of left mini-neglect in struggling readers
3. Significant magnocellular involvement in LMI in Unselected Sample
4. Support for "spotlight" of visual attention

Reference

(1) Hari et al. (2001). *Brain*, 124, 1373-1380.

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