MagnoFly: Game Based Screening for Dyslexia

James A. Ferwerda and Brendan Rehon
Progam of Computer Graphics, Cornell University

Abstract: Dyslexia is a reading disorder that affects approximately five percent of the population. Recent research suggests that deficits in the motion sensitive magnocellular pathways of the visual system may play an important role in some forms of the problem (Stein & Walsh '97, Pammer & Wheatly '01, Talcott et al. '02). Testing magnocellular motion sensitivity in young children could help identify those at risk for developing dyslexia, however existing tests are time consuming, boring, and difficult to administer. To address this issue we have developed a computer game called MagnoFly that evaluates a player's magnocellular function using motion coherence patterns. The player's task in the game is to protect babies from swarms of flies. Initially the swarms move randomly, but over time one swarm moves coherently toward one of the babies. The player gains points by spraying the aggressive swarm, but loses points by spraying indiscriminately. Over the course of the game a background process varies the swarm motion, and thereby measures the player's motion coherence threshold. At the end of the game a report is generated that allows physicians and other specialists to review individual results and determine if further evaluation for dyslexia is indicated. This work demonstrates the potential for using computer games as an enjoyable and effective platform for testing children's vision.

motivation

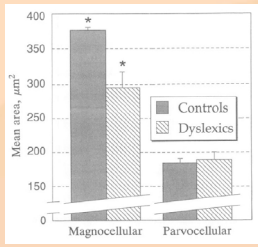
- dyslexia is a genetically linked reading disorder that affects ~ 5% of the population
- early screening could facilitate interventions, minimize learning disabilities
- however current tests only diagnose dyslexia *after* reading problems have occurred
- goal is to develop a simple test that can be used to predict if a pre-literate child is at risk

background: neurobiology of reading/dyslexia

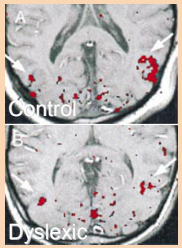
- reading is a complex sensory/cognitive skill
- many parts of the brain involved (vision, audition, language, memory)
- two main processing tasks
  - orthographic (letter/word recognition/parsing)
  - phonological (grapheme to phoneme conversion/linking)
- most dyslexics have phonological problems
- many also report orthographic difficulties

visual factors in dyslexia

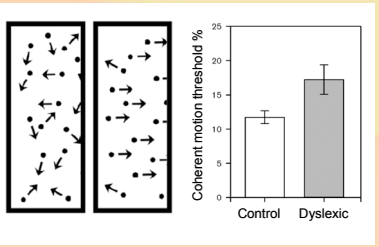
- effective reading depends on two distinct visual skills
  - letter/word recognition
  - controlled movement of eyes across text
- supported by magnocellular/parvocellular visual subsystems
  - parvo – central, high res., motion insensitive ~ letter recognition
  - magno – peripheral, low res., motion sensitive ~ eye movements, attention
- growing evidence that many dyslexics have magno impairments
- coherent motion displays can be used to test magno function



anatomical differences
(Livingstone et al. '91)



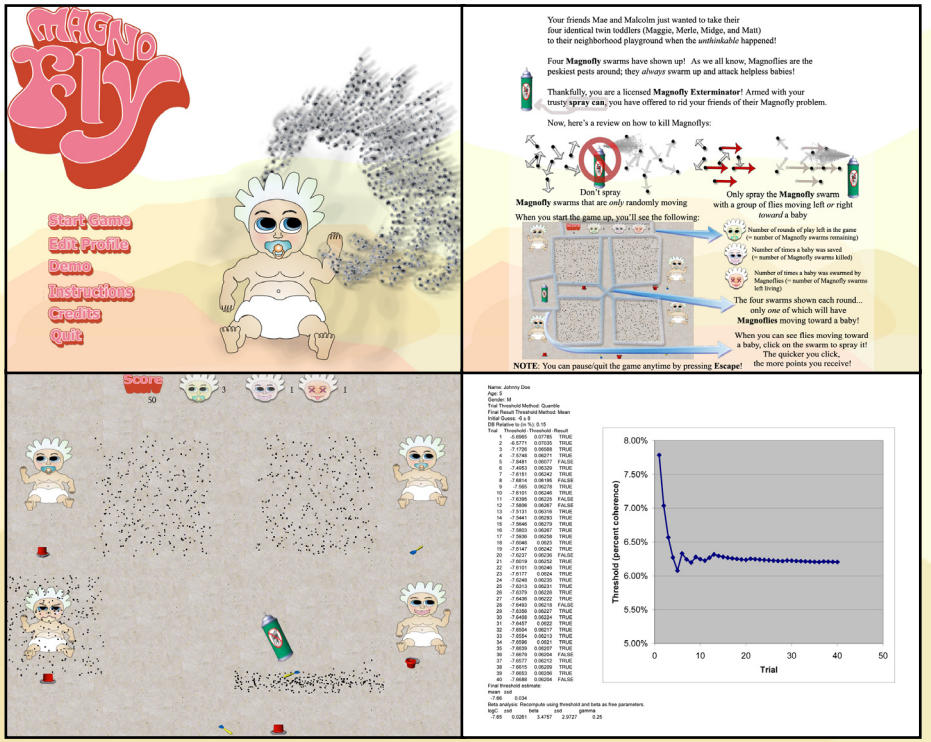
FMRI motion response
(Demb et al. '97)



coherent motion thresholds
(Stein & Walsh '97, Whitton et al. '98, Wilmer et al. '04)

MagnoFly:

- computer game to test magnocellular motion sensitivity in children
- player's goal is to protect babies from swarms of flies
- initially swarms move randomly, but over time one begins to attack a baby
- player gains points by spraying the aggressive swarm but loses points by spraying indiscriminately
- a background process varies swarm motion to measure the player's motion coherence threshold



impact:

- new tool to screen children for risk of dyslexia
- enjoyable/motivating game context, standard PC platform
- future work: testing, validation, more vision games

This work was supported by NSF ITR/ grant 0113310 and the Cornell Program of Computer Graphics.