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A Device for the Objective Assessment of ADHD Using Eye Movements

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Faculty Advisor: Paul A. Wetzel, PhD

Abstract

Attention deficit hyperactivity disorder (ADHD) is a commonly diagnosed psychiatric disorder characterized by impulsive behavior, impaired focus, and hyperactivity. Current methods of pediatric diagnosis rely on subjective measures of activity and behavior relative to other children. Proper diagnosis is critical in preventing unnecessary prescription of the powerful, habit-forming drugs used to manage ADHD, such as Adderall and Ritalin. Research has shown that individuals with ADHD show abnormalities in reading and antisaccade tests, as these stimuli gauge ability to focus and suppress impulsive behavior, respectively. Our goal was to design and construct a dedicated eye tracking device capable of accurately and objectively screening children for ADHD. The device was to be both inexpensive and accessible by non-experts in eye tracking, such as school nurses, optometrists, and family physicians.

Clinical Need

- ADHD is frequently misdiagnosed
- Requires extensive diagnosis time and must be performed by a physician
- Current testing is subjective
- Affects child’s academic and social development
- Treated with powerful drugs (Ritalin, Adderall)

Attention deficit hyperactivity disorder (ADHD) is a commonly diagnosed psychiatric disorder characterized by impulsive behavior, impaired focus, and hyperactivity. Current methods of pediatric diagnosis rely on subjective measures of activity and behavior relative to other children. Proper diagnosis is critical in preventing unnecessary prescription of the powerful, habit-forming drugs used to manage ADHD, such as Adderall and Ritalin. Research has shown that individuals with ADHD show abnormalities in reading and antisaccade tests, as these stimuli gauge ability to focus and suppress impulsive behavior, respectively. Our goal was to design and construct a dedicated eye tracking device capable of accurately and objectively screening children for ADHD. The device was to be both inexpensive and accessible by non-experts in eye tracking, such as school nurses, optometrists, and family physicians.

Design Approach

- A dedicated device easily used by non-experts
- Durable, portable, non-threatening appearance
- Limbus system for single-plane, monocular tracking
- Export quantitative results after analysis

Headgear

- Accounts for adjustment around the eye with 3D printed holder and flexible tubing
- Adaptable for each patient

Product Circuitry

- Reading Task
  - Uses Miller and Coleman reading passages
  - 5 passages of increasing difficulty in random order
  - Evaluates ability to focus on a task for an extended period
- Anti-saccadic Task
  - Uses horizontal step target motion
  - Subject eye movement must mirror target motion

Analysis

- Two-point central difference method used to determine velocity
- Velocity and acceleration thresholds set to identify saccades
- Time interval between saccades define fixation periods

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References