Digital self-assessment application for identifying ADHD symptoms

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I Introduction

- Attention-Deficit / Hyperactivity Disorder (ADHD) is a common neurobehavioral disorder that impairs the quality of life in both children and adults. The main symptoms include inattentiveness, hyperactivity and impulsivity. ADHD is usually diagnosed in childhood and often lasts into adulthood.

- Currently there is no simple objective diagnostic or screening test for ADHD.

- ADHD is diagnosed by clinicians in a multi-step process, using highly subjective tools, such as questionnaires, sometimes supported by computerized tests (T.O.V.A., MOXO).

- With children in particular, the diagnosis is confounded by parent's subjective input and child's general intelligence level.

- There is need for an accessible screening tool that can assist adults with ADHD symptoms and help parents to decide whether to seek clinical assessment.

- Visual Acuity (VA): measures the minimal spatial resolution; near VA is measured using reading charts, such as ETDRS.

- Crowding: impaired target recognition due to the presence of neighboring distractor elements; a phenomenon that is related to one's reading ability.

- Various studies demonstrated the usefulness of VA under crowded conditions for measuring visual performance, both in adults and children.

Purpose

To test whether a paradigm based on spatial and temporal stimulation can be used to identify ADHD symptoms, both in young and adult participants.

References:

1. Yehezkel O, Sterkin A, Lev M, and Polat U. Crowding is proportional to visual acuity in young and aging eye. Accepted for publication in the Journal of Vision 2015
2. Lev M, Ludwig K, Gilaie-Dotan S, Voss S, Sterzer P, Hesselmann G, Polat U. Training improves visual processing speed and generalizes to untrained functions. Sci Rep 2014; 4:7251.

Financial interest: Glassesoff Inc. www.GlassesOff.com

II Methods

Each participant's visual acuity was examined by an optometrist in order to make sure the results are not confounded by poor VA. In addition, the group of young participants that were previously diagnosed with ADHD and the age-matched control group were tested for normal VA using a single E shape target using the eTest (see below) in order to rule out poor VA. All of the participants had VA of 0.1 logMar or better at near distance (15").

Participants

- **Adult ADHD**, all are self reported as diagnosed ADHD by specialist:
  Number of participants: 28 (14 males); Age average: 25.6±10.4 SD.

- **Adult control:**
  Number of participants: 17 (8 males); Age average:25.2 ± 3 SD.

- **Young ADHD**, all reported by their parents as diagnosed as ADHD by a clinician:
  Number of participants: 21 ; Age average 9.3± 2.7 SD.

- **Young control participants:**
  Number of participants: 43 (23 males); Age average 9.5± 4 SD.

eTest

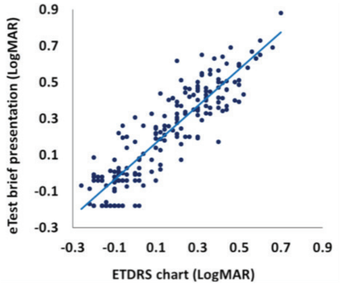
Measurements were made using a prototype dynamic digital assessment tool[1,2], currently developed by GlassesOff™, on smartphones, previously shown to reliably measure functional near VA, and were compared between diagnosed-ADHD and control groups. The test can be performed on any kind of screen (mobile or PC). Here we present testing results on mobile device screens:

- **Testing distance of 15".**

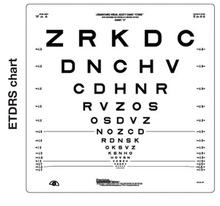
- **Stimuli:**
  - E-shape target embedded within a 5X5 matrix of similar E-shapes, with a randomly chosen orientation: Up, Down, Left and Right.
  - Two spacing distances: 0.4 and 1 letter, producing crowding.
  - Presentation duration: between 30 to 240 milliseconds (msec).

- **Task:** to detect the orientation of the central E-shape (i.e., the target).

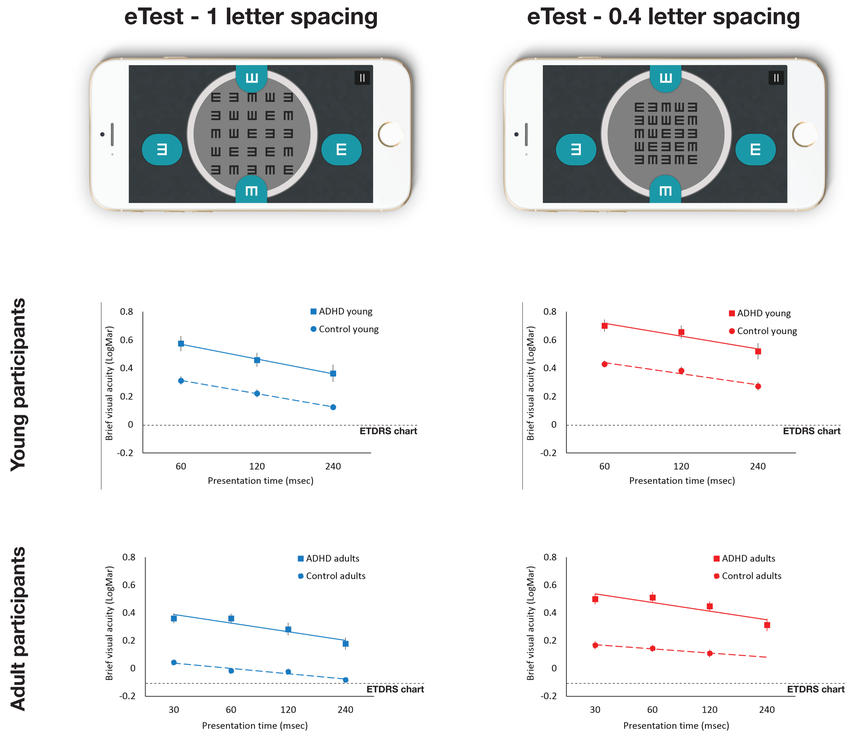
Minimal detectable target size for each combination of presentation duration and spacing distance was measured in a separate lock, using the adaptive ("staircase") method.



Correlation of 90% between ETDRS chart and eTest



III Results



Despite normal VA on the clinical static ETDRS chart, our test showed a large and significant reduction in visual performance in ADHD subjects compared to controls, in both age groups and for all presentation times and spacing distances.

IV Conclusions

- We developed a self-administered dynamic digital tool that may be used for objective assessment of ADHD symptoms and can constitute an objective screening tool to assist clinical diagnosis of ADHD.

- This tool ensures the results are not confounded by poor VA by confirming intact VA in the single letter target testing block.

- This tool is very easy to operate and can be used practically anywhere by anyone.

- We suggest that under-development of visual functions, which normally characterizes vision in young children, persists in adults with ADHD symptoms and becomes apparent under spatial and temporal load conditions.