

Digital precise remote near visual acuity evaluation using mobile devices

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INTRODUCTION

- **Visual Acuity (VA)**: measures the smallest spatial resolution one can read; near VA is measured using reading charts, such as ETDRS.
 - **Visual functional**: how the eye functions, i.e., measured using one parameter at a time in an artificial environment (e.g., Visual Acuity).
 - **Functional vision**: how the person functions, i.e., actual functioning in a real life environment, where multiple parameters can change and interact.
- The two terms are related but not similar. For example, VA can't accurately predict one's reading ability.
- **Crowding**: impaired recognition of a supra-threshold target due to the presence of distractor elements near the target; a phenomenon that is related to one's reading ability.

PURPOSE

To develop a tool for precise remote self-assessment of near visual acuity in order to accurately and remotely estimate the functional reading acuity.

METHODS

- We used an application by Ucanasi Inc., developed for iOS-based mobile devices (iPhone, iPad, iPod):
 - The test can be performed on any kind of screen (mobile or PC).
 - The technology was tested both on mobile devices and PCs.
 - Here we present testing results on mobile device screens.

eTest

- Testing distance of 40 cm.
- E-shape target in a 5X5 matrix with a randomly chosen orientation: Up, Down, Left and Right.
- The task: to detect the orientation of the central E-shape (i.e., the target).
- Matrix presentation duration: between 30 to 240 msec to compensate for the larger pixel size on PC screens.
- Two spacing distances: 1/2 and 1 letter, producing crowding.
- The test is divided into blocks: each block measures the minimal detectable target size for a single duration and spacing using the staircase method.

ETDRS Chart



Screens

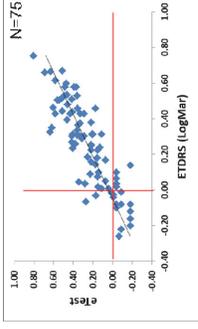


Crowding in eTest



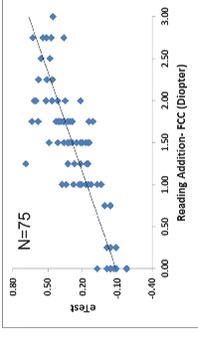
RESULTS

ETDRS vs. eTest Correlation



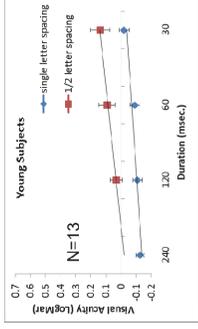
Correlation of 84% between ETDRS chart and eTest
eTest: mean of 0.27 ± 0.03 logMar, ranging between -0.26 and 0.76
ETDRS: mean of 0.25 ± 0.03 logMar, ranging between -0.18 and 0.91

Objective Measurement Correlation



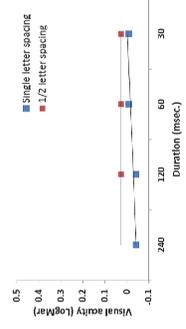
Correlation of 85% between fused cross-cylinder test (FCC) and eTest
eTest: mean of 0.27 ± 0.03 logMar, ranging between -0.26 and 0.76
Addition: mean of 1.33 ± 0.09 , ranging between 0 and 2.75 D.

Young Subjects Crowding



Center-to-center spacing between letters is highly relevant for the effect of crowding on letter recognition and reading.

Functional Vision



Age 36, Near ETDRS VA -0.04 logMAR (-6/6)

Despite the similar VA, functional vision is different.

CONCLUSIONS

We developed a tool for remote self-assessment of near visual acuity using an iOS-based application and PC:

- Very easy to use, accurate and effective.
- May be used on any screen.

eTest better predicts the functional visual acuity compared to standard measurements due to:

- Brief stimuli presentation (similar to single fixations during reading).
- Letter matrix better estimates the functional reading acuity as opposed to single letters used in reading charts.