C&Look: A platform supporting children with oculomotor dysfunctions

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Abstract

Oculomotor dysfunction (OMD), a coordination problem between a child's left and right eyes, is rarely diagnosed and even less frequently treated. This research presents C&Look, an eye-tracking (ET)–based platform that uses serious games to generate objective measurements of eye movements and reveal coordination problems. The platform supports identification, analysis, and, when needed, vision training, while outlining the current state of the art of its development. We argue for its future use as a disruptive innovation in schools. This extended abstract highlights key aspects of C&Look's development and the potential for integrating ET technologies into school-based vision screening.

1. Introduction

Visual attention is considered a facilitator of the development of complex cognitive skills and a particularly salient predictor of academic outcomes. A well-documented problem in vision and eye care is the lack of attention to vision diagnostics for children, for examining oculomotor dysfunction (OMD), a coordination problem between the eyes. Identifying OMD is about how one's vision system functions; it is rarely done during routine health and vision checks for children. Parents and guardians rarely notice the problem; a child may not be aware of it, or her complaints may be misdiagnosed, such as dyslexia or behavioral problems (Wilhelmsen, 2016). Vision specialists familiar with OMD (eye-care practitioners) are few and lack the resources to screen all school-aged children (Eide et al., 2019). The screening requires a time-consuming consultation with the child's specialist, which relies on the specialist's observations. This screening is time- and resource-intensive and rarely includes assessment of children's functional vision unless it is obviously severe. The last mandatory health check at ages 4–5 includes vision screening, yet their vision is still developing when they begin school. 25–30% of school-aged children have vision problems (EuroSTAT, 2014), and up to 85% of these problems go undetected (Falkenberg, Langaas, & Svarverud, 2019; Johnson, Blair, & Zaba, 2000; Kocur & Resnikoff, 2002). OMD, as a vision impairment, can cause later impediments to academic success, the education system, the public health system, and social well-being (Ali et al., 2021; Zaba, 2001).

This study focuses on sketching the main steps of a solution that can help children's vision, also with OMD, between the ages of 6 and 14, a critical period in their vision development (Dodick et al., 2017; Gunvor Birkeland Wilhelmsen & Marion Felder, 2021), to: a) **identify** such vision problems, b) help with **training or therapy** towards better vision, since many of the functional vision problems, such as OMD, can be corrected by training. While many patients with non-severe OMD can train their vision and see better (Eide et al., 2019; Gunvor B Wilhelmsen & Marion Felder, 2021), enabling support for the c) **analysis** of these problems needs further examination.

The aim of this extended abstract is to present C&Look, a platform developed to support identification, training, and the analysis of vision functions using affordable eye trackers and software applications. While the hypothesis is that the solution works for adults as well, many of the studies included in the development and testing of C&Look focused on children in their early school years. This extended abstract summarizes lessons from studies conducted during the development of C&Look, while a more coherent description and argument for its intended use and current possibilities should be presented in a longer paper.

2. The possibility of screening vision at schools

To effectively help children through training or therapy and ensure they have the necessary resources, having C&Look, or similar tools, to support professionals like clinicians, vision specialists, opticians, etc., is not enough; they still lack the resources to monitor all children's vision. Children's vision should be screened more frequently at the start of school, when their vision is developing, and their main activities are changing. For example, they need to begin working longer periods at closer distances, such as writing and reading. Given the insufficient number of required screenings across countries, this work suggests including vision screening as part of school activities. Figure 1 illustrates this possibility.

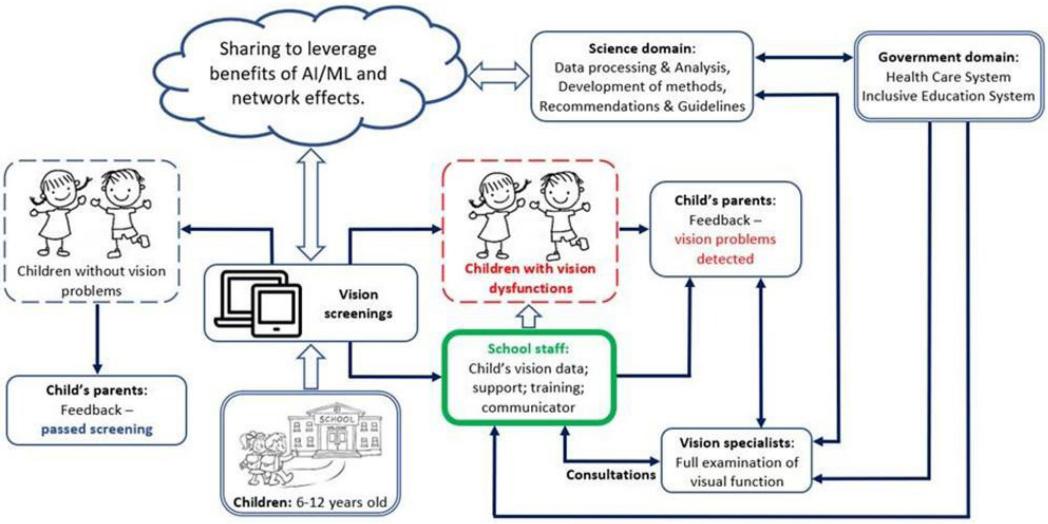

Figure 1 The illustration shows that OMD identification can be done at schools. Since ET technologies can detect healthy vision, children with possible vision problems will be referred for further examination. The image is done together with Gunta Krumina and Vlad Fomin.

As Figure 1 illustrates, to implement screening in schools, several issues beyond the affordable "system" (ET, software, computers) are necessary, such as assigning responsibility for screening, determining when and to whom to report results, addressing vision disturbances, and planning vision training. This means handling an ET-based screening as a disruptive service innovation (Gomolka, Kordos, Dudek-Dyduch, & Twarog, 2025). Ensuring competence and resources in schools can also mean taking some responsibility away from clinicians. While we posit that school staff do not need to be health experts, they will still need to assist with health issues in their daily work with children (Little et al., 2025). To use C&Look, school management should empower school staff to address children's vision by providing a supportive framework for vision support and coordination of all involved stakeholders (Ali et al., 2021; Heldal et al., 2021). Since there are several ET-based screenings for several vision functions, C&Look can later address several vision disorders, for example, non-strabismic accommodative and vergence dysfunctions (Wajuihian & Hansraj, 2015).

Approximating broader impact can be achieved through a preliminary cost-benefit analysis based on 2021 data, calculated after screening over 400 children with vision teachers, and informed by statistics from Tanzania and Norway. If all school-age children underwent vision screening annually and those with positive results also received vision training, the estimated rate of vision problems would be 30%, of which ⅔ would be previously undetected. Without such a vision screening system, a specialist would need 30 minutes per child for screening, 20 minutes for positive cases, and 10 hours of face-to-face training. With C&Look, they will still need 15 minutes for diagnosis confirmation and 1 hour for treatment follow-up, according to earlier studies (Eide et al., 2019). School personnel need 15 minutes for screening and 10 hours for training supervision for each group of 8 positive children. Thus, the screening time spent on each child will be about the same, divided between the health and school systems, saving the specialist time and lowering the total cost. Importantly, this solution will eliminate the waiting time to see a specialist, which can be several months, according to the Euroscreen report (EUScreen, 2019). The training time will be reduced from 10 hours face-to-face to 1 + 10/8 = 2,25 hours per child on average, again at a lower cost. On a national level, this results in significant savings while contributing to a systematic vision care system.

3. Technical possibility

Nowadays, several studies suggest that eye-tracking (ET) technologies can enable faster assessments of functional vision. There are multiple research- and profit-driven organizations working on solutions to support the identification or treatment of OMD or other functional vision problems, but these technologies are designed for clinicians and require specific technical settings and software. Most ET devices are from commercial developers and using them demands additional knowledge to adapt to the environment and users. Identifying OMD issues, providing training and therapy, and understanding analysis needs require distinct skills, especially when supported by technology. Many commercial solutions use fixed technologies and software; upgrades, modifications, and adjustments are often difficult. According to our current knowledge, there are no computer-supported vision screening and training programs at schools. There are a few computer-supported programs (e.g., RightEye, or VisionBuilder, or Thomson's solutions) for OMD, devices supporting autorefraction (e.g., SureSight, Plusoptix, SPOT 2), photoscreeners (e.g., MTI photoscreener, iScreen 3000), or mobile-based software programs (e.g., VERA, EyeSpye) testing certain aspects of vision, or Lexplore (testing reading ability). These are all parts complementing a thorough vision screening or training. The cost of these is often too high for schools to use, or they are too complex for non-specialists. Existing AI-based tools and techniques (e.g., CNN, VGG16, AlexNet, DeepID, iTracker) for eye tracking do not yet focus on the current diagnosis

(e.g., OMD, spasm of accommodation diagnosis) and thus can only be considered in the development of the techniques as a reference point for future/further development.

4. Snippet from the basic parts of C&LOOK

The Project addresses children's vision problems holistically by tackling the network of stakeholders' responsibilities in children's health care (parents, schoolteachers, school nurses, vision care specialists) and soliciting schools' participation for a real-life demonstration of feasibility. Figure 2 illustrates a person reading and highlights four eye movements. Here (not shown), the x-axis is time, and the y-axis is horizontal POG distance from the left of the screen. As shown in this plot, fixations are nearly horizontal lines, i.e., the eyes are focused on a single point over time. On the other hand, saccades and regressions are nearly vertical lines (in opposite directions), indicating rapid movement from one point to another. Lastly, we observe glissades that correct the previous saccade/regression. Smooth pursuit is not shown here, but it would look like a diagonal line with no acceleration.

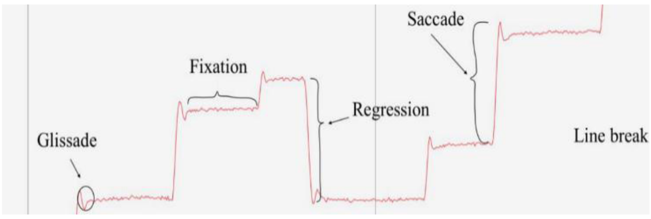

Figure 2. The four important eye movements registered by an ET during a reading task.

The tasks involve tracking objects on the screen and comparing the movements of the objects with the movements of the left and right eyes. These need to be coordinated, and a simplified version of the horizontal movements is shown in Figure 3.

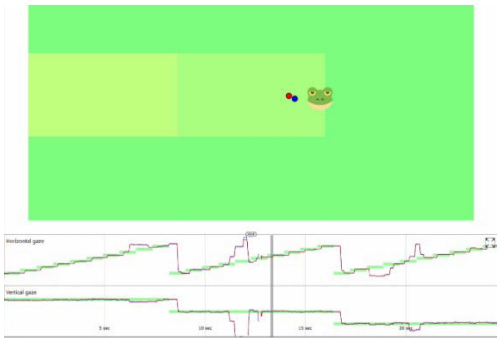

Figure 3. The video follows the frog's graphical representation on the screen, superimposed with the eye-gaze representations from the left and right eye. The dark green shows correct coordination.

5. Future work and corrent lessons

In the final paper, we argue for both the technical feasibility and the institutional relevance of the C&Look platform. The results will demonstrate how ET-based screening can be integrated into everyday school routines without overloading existing health services. The preliminary findings suggest that such an approach can improve early detection, reduce waiting times, and create a more equitable pathway to vision care for children. Overall, these insights indicate that C&Look has the potential to serve as a disruptive innovation that transforms how societies understand, organize, and provide children's vision services. Future work will focus on developing and validating an integrated system that shows technological robustness, measurement accuracy, economic viability, and institutional feasibility. Such a system would establish a solid foundation for largescale national and international adoption, enabling network effects and ongoing improvements in diagnostic accuracy and training effectiveness through advanced AI models.

This work also highlights the value of an interdisciplinary approach, involving researchers from social science, organizational science, computer science, and vision science, along with practitioners who develop health technologies and conduct vision screening.

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