

## Editorial

# Making New Connections

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I remember how excited I was when I first learned to perform ophthalmoscopy. It was in 1981, my second year in optometry school. We were primarily taught using a direct scope back then, as the use of diagnostic pharmaceuticals was not yet a “privilege” within New York State’s scope of practice. Nonetheless, I recall the initial thrill of visualizing the central retinal landmarks and vasculature and learning to differentiate deviations from “normal”. One year later, as I timidly approached my very first clinic patients (not to mention taking 90 minutes to do a primary care exam) I took great pride in explaining to them how an examination of their eyes enabled me not only to check their eye health but, also, to diagnose a host of other conditions. It made me feel like a “real doctor”.

Over these many years in clinical practice, I have remained just as fascinated about what the eyes have the potential to “tell us”. My interest in the eye-brain connection is increasingly piqued as research unveils even more brain disorders that can be assessed with eye-tracking and related methods of assessment. Neurological disorders potentially detectable through eye tracking technology include autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), Parkinson’s Disease and Dyslexia, among others.

When recalling that the neural circuits that control eye movements are intricately distributed in brainstem, basal ganglia, cerebellum, and multiple areas of cortex it’s reasonable to consider the potential of clinically harnessing these “neuro-signaling” relationships.<sup>1</sup> Indeed, eye-tracking technology capable of detecting subtle deviations from conventional eye movement patterns, can provide us with non-invasive, clinically useful means of screening for brain health.

Investigation of the potential of eye tracking tests has been conducted in many neurological disorders. For example, studies using eye tracking in children with ADHD have shown accuracy rates of up to 77% in differentiated affected children from typically developing peers.<sup>2</sup> Additionally, when existing ADHD assessment tests were combined with eye tracking techniques, diagnostic precision was enhanced.<sup>3</sup>

In the toddler and pre-school population, eye tracking can be used to collect eye movements and gazes, assessing both the direction and latency of movement. Subjects with ASD can be distinguished from those who are normally de-

veloping. Several Eye-tracking devices are available, some of which are screen-based and can be used on remote systems or desktop systems, and another is eye glass-based. The clinical diagnostics evaluated with these technologies include saccades, fixation, scan path, and blink rate.<sup>4</sup> Similarly, eye tracking can be instrumental in diagnosing dyslexia by analyzing eye movements while reading to identify patterns that indicate underlying difficulties. Here again comparative data regarding, fixations, saccades, regressions and fluidity of excursions are compared to a normal population.<sup>5</sup>

Parkinson’s Disease (PD), primarily associated with motor dysfunction, also affects vision and eye movements. In PD, saccades are inaccurate and fall short of their intended targets.<sup>6</sup> Periodic reassessment of eye movements is clinically useful in monitoring the progression of Parkinson’s over time. Lastly, eye tracking studies show that children and adults with dyslexia typically take longer to scan words, move their eyes shorter distances, and exhibit fewer word-skipping behaviors while reading. Incorporating eye movement tracking tests into assessments of patients with learning or reading disabilities, enables specialists to identify and address reading difficulties early in the learning process.<sup>7</sup>

Rapidly evolving is the current focus of investigation on the relationship of ocular neuroanatomical changes to neurological disease, specifically Alzheimer’s Disease. In Alzheimer’s disease, a gradual decline in brain function typically comes before full-blown symptoms like memory loss. Eye tracking tasks, which challenge individuals’ ability to remember and find items on a computer screen, have shown a high sensitivity and specificity in detecting mild declines in key brain functions early on. Additionally, a recent study (N=32) of patients with established disease showed reduction in visual memory, decreased on task pupil modulation and increased time for visual search, compared to age-matched controls.<sup>8</sup>

Given that our profession’s educational curriculum is so well grounded in oculomotor function and visual processing, I call upon us all to take a proactive approach in heightening our clinical attention to the eye-brain connection.

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